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**Ecological Survey of
HORSE MEADOW, SAN BERNARDINO COUNTY**

CANDIDATE RESEARCH NATURAL AREA

San Geronio Ranger District
San Bernardino National Forest
United States Forest Service

Mary Theresa Burke
Davis Arboretum
University of California
Davis, California
1992

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CANDIDATE RESEARCH NATURAL AREA

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ACKNOWLEDGEMENTS

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This document describing Horse Meadow was prepared as a companion piece to two other candidate RNA reports: Broom Flat RNA Establishment Report and Fisherman's Camp RNA Establishment Report. The portions of this report which deal with general information about the San Bernardino Mountain region are shared in part or in full with these reports. They are filled as separate reports in order that each candidate RNA site may be considered individually.

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I. INTRODUCTION

SITE DESCRIPTION

The Horse Meadow candidate Research Natural Area covers approximately 946 acres (378 ha) south of Barton Flats, San Bernardino County. Horse Meadow includes the ridgeline and north- to northeast-facing slopes of a northwest-southeast trending ridge. This area, included entirely within the San Gorgonio Wilderness, supports more or less homogeneous stands of white fir (*Abies concolor*), the target element for this candidate Research Natural Area. On the gentle slopes at the eastern boundary of the site, species characteristic of the southern mixed conifer forest¹ (*Abies concolor*, *Pinus jeffreyi*) occur in either mixed stands, or as stands dominated by either the white fir or the jeffrey pine. Here, in this mixed conifer forest, some white firs reach very large sizes. At the northwestern corner of the site, black oak (*Quercus kelloggii*), a broad-leaved and winter-deciduous tree, is scattered among the taller conifers. In the wet and springy soils found along spring-fed creeks, riparian and other mesic species (*Salix* spp., *Carex* spp., *Juncus* spp., *Mimulus* spp.) form flowery lush green meadows in clearings in the forest.

Aside from this gently sloping area near the eastern and northern boundaries, much of the Horse Meadow site consists of very steep, unstable slopes dominated by stands of much smaller and younger white firs. In rocky outcroppings high on the ridge, trees that find protection from the shallow and sliding soils typical of this site can reach large sizes. Two avalanche slopes occur in the candidate Horse Meadow RNA. Nearly impenetrable stands of chinquapin (*Chrysolepis sempervirens*), willow (*Salix* spp.) or snowbush (*Ceanothus cordulatus*) fill the chutes. At high elevations, and especially along the southern boundary where northwest-facing slopes give some protection from severe winter storms, lodgepole pine (*Pinus contorta* ssp. *murrayana*) forests occur in dense, even-aged stands. Limber pine (*Pinus flexilis*) is an occasional associate at high elevation, exposed sites.

Although the stands of white fir that occur here are not particularly impressive, they are considered typical of the white fir forest in southern California and it is unlikely that better quality white fir can be found in the San Bernardino National Forest (Horton 1982). The site includes an interesting assemblage of plant communities characteristic of moderate to high elevation areas in the San Bernardino Mountains. Three sensitive plants occur within the proposed boundaries of this candidate Research Natural Area: Barton Flats Horkelia (*Horkelia wilderae*), Heckard's Indian Paintbrush (*Castilleja montigena*), and Mountain Dandelion (*Taraxacum californicum*).

¹ Holland (1986) assigns the name "jeffrey pine-fir forest" to this forest type; however, as "mixed conifer forest" is widely used by the US Forest Service and others, the terms are used interchangeably in this report.

PHYSICAL DESCRIPTION

South Fork Trailhead, the access point for the Horse Meadow candidate RNA, is approximately 21 miles (34 km) south of Big Bear City in San Bernardino County, California (See Map 1: Vicinity Map; Map 2: US Forest Service Vicinity Map). Horse Meadow may be reached by travelling State Highway 38 from either Big Bear City to the north or from Mill Creek/Redlands, 25 miles (40 km) to the southeast. From Highway 38, a well-maintained paved road, Jenks Lake Road, leads from both the east and west ends of the Barton Flats area to the parking area at the South Fork Trailhead. From here, the popular and heavily used South Fork Trail leads into the San Gorgonio Wilderness along a well-marked trail over easy to moderate terrain and parallels the South Fork of the Santa Ana River for some distance (Map 3: US Forest Service San Gorgonio Wilderness Map). It is approximately a one mile (1.6 km) hike from the trailhead to the northern boundary of the candidate Horse Meadow Research Natural Area. A gated and locked paved Forest Service road, Road 1N78, leads from Jenks Lake Road to Poopout Hill at the northern boundary of the site, bypassing the one mile climb from the public parking area at South Fork Trailhead. This road could provide vehicle access to an entry point of the Horse Meadow site for researchers with heavy equipment to transport.

Along the northern, eastern and southern boundaries, travel is easy along the paved Road 1N78 (northern boundary), the South Fork Trail (eastern boundary), and the Dollar Lake Trail (southern boundary). Except for along the gentle slopes at the eastern periphery of the site where the understory is generally open, travel throughout most of the area is difficult as the slopes are very steep. The ridgetop and upper reaches of the forest are best reached by travelling northward from Dollar Lake Saddle along Forsee Creek Trail, then dropping into the top of the site along the 10,400 ft. contour line. Access into the dense, waist- to head-high, and sometimes armed vegetation of the avalanche slopes is difficult from any approach. As is customary in backcountry travel, water must be carried.

ADMINISTRATIVE LOCATION

The proposed Horse Meadow Research Natural Area includes portions of Sections 22, 26, 27, 34 and 35 in Township 1 North, Range 1 East, just south of Barton Flats. The study area is covered by the MOONRIDGE, CALIF. U.S.G.S. topographic map (1:24,000; 7.5 minute, 1990). See Map 4: Topographic Map. The site is northwest of San Gorgonio Mountain-- or "Greyback" as it is known locally-- the highest peak in southern California at 11,502 ft. (3508 m) and the prominent feature for which the wilderness area is named. The Horse Meadow candidate RNA lies wholly within the San Gorgonio Ranger District of the San Bernardino National Forest. District offices are at the Mill Creek Station in Mentone, California; Forest Headquarters are in San Bernardino, California. Like all visitors to wilderness areas, researchers must carry written permission to use the wilderness. A letter authorizing extended

use may be requested in lieu of a daily wilderness permit from the San Geronimo District Ranger; collecting permits may be requested as well. Researchers are expected to be familiar with and follow all forest and wilderness regulations.

JUSTIFICATION

In the transmontane region of California, *Abies concolor* is a typical component of the mixed conifer forests that dominate the mid-elevation sites of southern California mountain ranges. In these forests, the most extensive western coniferous forests between the Sierra Nevada of central California and the Sierra San Pedro Mártir of Baja California, white fir intergrades with sugar pine, *Pinus lambertiana*, and jeffrey pine, *Pinus jeffreyi*, in response to local environmental conditions. However, on steep, moist, north- and east-facing slopes and along ridges at higher elevations, white fir forms a distinct plant community. This open coniferous forest, with a typically sparse and depauperate understory, usually occurs over 7800 ft. (2400 m.) and is dominated almost exclusively by *Abies concolor*.

In California, white fir is common above 6000 ft. (1800 m) in mountainous regions from San Diego to the northern Sierra Nevada and southern Cascades. In the Sierra Nevada, *Abies concolor* typically occurs in a mixed conifer forest and, as in the San Bernardino Mountains, dominates in relatively mesic sites where white fir can comprise 80% or more of the large trees in individual stands (Rundel et al 1988). Unlike the San Bernardino Mountain white fir forests, however, in the Sierra Nevada understory trees and shrubs are an important element in the community type. There, species such as *Acer macrophyllum*, *Arbutus menziesii*, *Quercus kelloggii*, *Q. chrysolepis*, *Chamaebatia foliosa*, and various *Ceanothus* species may contribute 5-10% of coverage, with 30% or more not unusual. Much like the Horse Meadow white fir forest, herbaceous cover is sparse in the Sierran forests and may be completely absent where deep litter accumulates.

Holland (1986) notes that the southern California white fir forest, while similar to the Sierran white fir forest, occurs on sites that are higher, colder, and probably drier. Confined to steep slopes between 7500-9500 ft. (2300-2900 m) where the snow lingers late in the year, the southern California white fir forest is thought to be a somewhat drier southern equivalent of the red fir forests of the Sierra Nevada. The southern California white fir forest is found in scattered locations in the southern Sierra Nevada and the highest parts of the Tehachapi Mountains; on Mt. Pinos; and is common at high elevations in the eastern San Gabriel Mountains, the San Bernardino Mountains, and in the San Jacinto-Santa Rosa Mountains.

In 1969 and 1974, the vegetation of the San Bernardino Mountains was mapped on eighteen 1:24,000 and 1:62,500 USGS topographic maps (Minnick, 1969 and 1974). Working from infrared aerial photographs (using Kodak Ektachrome Infrared Aero (CIR) Types 8443 and 2443), a highly generalized vegetation map of the San Bernardino Mountains was produced. This general vegetation map clearly shows overall trends and relationships between

vegetation types, especially the horizontal banding of plant communities in response to elevational change (Map 5: General Vegetation Map of the San Bernardino Mountains). In his description of the vegetation of these mountains, Minnick (1976) treats the white fir forest as a variant of the western coniferous forest (called mixed conifer forest by other authors, jeffrey pine- fir forest by Holland). As is apparent in areas highlighted by color in Map 6: Western Coniferous Forest and Lodgepole Pine Forest in the San Bernardino Mountains (Minnick 1976), these forests are widespread between 6000-9000 ft. (1800-2750 m); however, the locations where *Abies concolor* and *Pinus lambertiana* are dominant over *Pinus jeffreyi* and *Pinus ponderosa* are relatively few (denoted by "SF" code, red color).

As noted in the site description, the candidate Horse Meadow Research Natural Area includes, in addition to the extensive white fir forest, a variety of montane plant communities characteristic of mid- to high-elevation sites in the San Bernardino Mountains. The meadowy areas and willow thickets along the watercourses, together with the densely vegetated avalanche chutes, although difficult to study, contribute to the overall habitat diversity of the area.

II. PHYSICAL FEATURES

GEOGRAPHY

Along with the San Gabriel Mountains to the west, the San Bernardino Mountains are included within the Transverse Range geomorphic province of California. Running eastward from Santa Barbara to the Mohave-Colorado deserts, the Transverse Range is an important transition zone between the floristic elements of northern and southern California (Hanes 1975). The northern portion of the range rises gradually from the valley floor on the west at 5000 ft. (1500 m) to form a gentle, undulating crest area that gradually increases in elevation to 7850 ft. (2400 m) north of Big Bear Lake. This area of relatively low relief and gentle hills and deep soils is an old-age surface, dating back to the early Quarternary. From Big Bear Lake, the crest of the San Bernardinos veers southeast to the highest portion of the range where the Santa Ana River and Mill Creek drain two prominent ridges on the main mountain plateau (Minnick 1988). Here the San Bernardino Mountains reach their highest elevation on the prominent San Gorgonio Mountain at 11,502 ft. (3508 m).

Horse Meadow candidate Research Natural Area is in the midst of these prominent ridges that form the main crest of the mountain range. Lying on the north- and northeast-facing slopes of the ridge between San Gorgonio Mountain and San Bernardino Mountain, Horse Meadow is a high elevation, mesic site that shows evidence of high winter precipitation and heavy snow pack. Elevations within the candidate Research Natural Area range from 7520 ft. to 10,230 ft. (2294 m to 3120 m). Slopes vary from 7° at the northern end of the site near Road 1N78 and on a nearly level bench at midslope to 30° along the steep terrain of the northeast-facing slopes near the contour point marked 10,230 ft. at the western boundary of the site.

Several intermittent streams drain Horse Meadow along the northeast-facing slopes. These unnamed creeks water a series of meadows in South Fork (outside the site boundaries) and are part of the headwaters of the South Fork of the Santa Ana River. San Y Ca Spring and a second mapped but unnamed spring are year-round springs near the northern boundary of the site. Unlike the streams that drain the northeast-facing slopes, these springs feed into the Frog Creek watershed. Other temporary springs may occur at Horse Meadow. Morainial accumulations of glacial deposits occur on this site; large amounts of water are retained by glacial till and springs frequently flow from the slopes of such glacial features. These temporary springs are due to the highly irregular arrangement of glacial debris and the resulting formation of impermanent local underground reservoirs. Such springs can arise and disappear within brief periods of time.

CLIMATE

As in most of California, vegetation in the San Bernardino Mountains is influenced primarily by the infrequent winter rains and prolonged summer drought typical of a dry Mediterranean climate. Within the mountains, the varied terrain and elevation produce a wide range of local climatic conditions. As winter storms move into southern California, moist southern winds travel in advance of incoming cold fronts. As this moisture-laden air moves up the slopes of the San Bernardino Mountains, precipitation increases from 15" (38 cm) annual precipitation in San Bernardino at the western edge of the mountains to 40" (100 cm) annual precipitation at the crest of the range. In the lee of the San Bernardino Mountains, a pronounced rainshadow effect occurs and precipitation decreases to less than 8" (20 cm) annually on the low elevation slopes bordering the Colorado and Mohave Deserts. During the dry season (April to November), storm activity nearly ceases except for occasional afternoon thunderstorms in July and August over the San Gorgonio crest region and in Big Bear Basin.

Much of the precipitation that occurs in the mountains falls as winter snows that accumulate in the mid- and high elevation coniferous forests. Here, a heavy snowpack ensures that soil moisture replenishment is delayed until the late spring melt frees the water at the beginning of the early summer growing season (Minnick 1988).

As mentioned above, Horse Meadow candidate Research Natural Area is along the main crest of the range; high winter snowpack is typical. Reasonably accurate weather data is surprising difficult to find for this site. The nearest year-round weather station is at Big Bear Lake (34°15'N, 116°53'W) at 6790 ft. (2070 m), a station obviously far removed in character, elevation and relation to the crestline from Horse Meadow. Nonetheless, as the nearest station, its records are included here.

Based on records from 1941-1970, the average precipitation at Big Bear Lake is 34.71" (88 cm) yearly. In 1990, the fourth year of a drought in California, annual precipitation was only 13.35" (34 cm). Winters and summer temperatures in this region of the San Bernardino Mountains are comparatively mild for a mountain environment: average temperatures range from 30° to 65°F (-1° to 18°C), with extremes ranging from a winter low of -7°F (-22°C) to a summer high temperature of 87°F (31°C). High elevations and cool temperatures result in a short growing season between mid-June and mid-September of about 100 frost free days per year.

Additional climatic data is available to researchers who are willing to piece together information from a variety of sources. The San Bernardino County Flood Control Department maintains temperature and precipitation records from two sites nearby: the Cal Trans site at Camp Angeles (Station #3053) and the Heart Bar Station (Station #2359). Both sites are extremely dissimilar in habitat to the proposed RNA. Camp Angeles is at about 5800 ft. (1770 m) in mixed conifer-oak woodland; Heart Bar, located just on the northeast side of the crest at 6800 ft. (2074 m), experiences enough of the rainshadow effect to be significantly drier

than the higher elevation San Gorgonio Wilderness area.

The Fire and Emergency Dispatch Center maintains temperature and precipitation records from a variety of stations for 6 months of the year (during fire season). The nearest station, called "Converse" is located north of Seven Oaks (Big Bear Lake 7.5 quadrangle, T1N, R1E, Section 8). This information is called in daily and recorded manually in books; no summary information is available but could be calculated from the daily records. The manager of the Dispatch Center has calculated a Forest precipitation average from the 15 fire/weather stations in the San Bernardino National Forest that keep records. During 1991, the Forest average precipitation was 27.64" (70.24 cm). Other nearby fire/weather stations include Mill Creek and Banning, both nearer to the San Bernardino valley floor and at much lower elevations; their records are therefore not included in this report.

Most useful, perhaps, is the information recently gathered by the State of California Department of Water Resources (DWR) on winter snowpack levels at two sites in the San Gorgonio Wilderness. This data was collected at two recently established "snow courses", permanent transects where snow height and water content is sampled at several points along the transects. The closest snow course is Christmas Tree Hill, located near the bottom of an avalanche slope near South Fork Meadows, approximately in the "northeast quarter of the southwest quarter" of Section 35, at 8600 ft. (2623 m) about 0.10 mile or 0.16 km (west of the Section 36 line. Another nearby snow course, Lower Big Draw, is southeast of Dry Lake (T1S, R1E, Section 1) at about 9400 ft. (2867 m) in a nearly level open area. Although snow course data was once routinely collected by DWR, funding disappeared for this labor-intensive task. These two snow courses were established only recently (1984) as the result of interagency funding to help predict the water supply for the Santa Ana River flood control district. Measurements will be made as long as funding continues. The data is no longer published, but is stored electronically and is available (in digital or paper form) at request from DWR. A sample of data from both sites is included (Table 1. Snow Survey Data: Christmas Tree Hill; and Table 2. Snow Survey Data: Lower Big Draw).

GEOLOGY

Roughly 75 miles (120 km) east of Los Angeles, the San Bernardino Mountains are the highest and most rugged mountains of southern California. This very young mountain range consists of three primarily granitic blocks of Mesozoic age that have been uplifted along the San Andreas Fault on the south and along a complex network of thrust faults on the north. The last major period of mountain building occurred during the mid-Pleistocene (300,000-500,000 years ago) and caused the major uplift and westward tilting of the mountain blocks.

The San Andreas fault splits the main part of the range into two structural blocks which differ from one another by both origin and basement terrane material. The north block is eroded from an elevated mass of granitic basement rock that is part of the granitic batholith

DEPARTMENT OF WATER RESOURCES
CALIFORNIA DATA EXCHANGE CENTER

SNOW COURSE # 351 -- CHRISTMAS TREE HILL

SANTA ANA R

3-LETTER ID: CTH
ELEVATION: 8500 FEET
NO. OF SAMPLE POINTS: 10
AVG APRIL 1 WATER CONTENT: 13.6"

LATITUDE: 34D 7' 36"
LONGITUDE: 116D 50' 42"
RECORD BEGAN 1962
ASPECT: WEST

MEAN DEPTHS AND WATER CONTENTS ARE IN INCHES

YEAR	JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE/SUPPLEMENT		
	DATE	DEPTH	WC	DATE	DEPTH	WC	DATE	DEPTH	WC	DATE	DEPTH	WC	DATE	DEPTH	WC	DATE	DEPTH	WC
1970				2- 5	.0	.0	2-27	.0	.0	4- 2	29.5	11.5	5- 1	20.0	8.0	3- 7	45.3	14.5
1971				1-28	41.3	13.6	2-25	42.8	15.8	4- 1	22.1	10.5	4-30	13.3	6.1			
1972				1-27	33.3	11.9	3- 1	27.0	11.7	4- 3	.0	.0	5- 2	.0	.0			
1973				1-29	50.0	10.1	2-26	72.2	24.0	3-29	92.4	23.6	5- 3	53.0	23.2			
1974				1-25	33.2	11.7	2-23	31.1	10.0	3-25	43.5	17.3	4-24	20.6	8.4			
1975				1-28	19.4	4.2	2-27	26.8	8.0	3-31	36.4	13.2	4-30	35.6	12.2			
1976				1-20	12.0	3.4				3-27	41.0	17.8	4-21	28.6	12.0			
1977				1-21	25.4	6.1	2-27	26.0	7.3	3-21	23.3	7.9	4-22	.0	.0			
1978				1-26	49.7	13.9	2-24	74.8	27.7	3-30	99.0	36.1	4-26	79.5	43.2			
1979				1-26	67.3	20.9	2-26	86.6	30.7	3-26	79.4	28.1	4-23	82.4	36.3			
1980																		
1981																		
1982																		
1983				1-25	51.5	16.3	3- 7	103.0	34.9				5- 2	100.7	43.9			
1984	1- 9	11.6	5.2	2- 8	11.0	4.8				3-25	.3	.1						
1985				1-27	44.8	13.1	3- 3	52.4	15.3	3-30	42.9	15.9	5- 5	.0	.0			
1986				2- 2	30.0	11.3	3- 9	33.3	12.1	4- 5	36.6	26.0	4-26	14.1	6.2			
1987							3- 7	43.9	12.0	4-13	29.2	9.7						
1988				2- 5	42.0	12.3	3- 2	32.1	11.7	3-29	18.7	7.4	5- 3	.0	.0			
1989							3-10	37.6	12.5	4- 5	16.8	7.7	5- 3	.0	.0			
1990				2- 2	21.7	4.3	2-28	35.7	9.9	3-30	23.5	7.9	5- 1	.0	.0			
1991	1-30	12.9	4.9	1-30	12.9	4.9	2-27	4.5	1.6	4- 3	73.0	25.0	4-29	38.0	18.8			
1992				2- 4	27.2	8.3	2-26	61.6	17.6	3-30	76.4	25.0	5- 4	24.7	9.8			

TABLE 1. SNOW SURVEY DATA: Christmas Tree Hill.
Department of Water Resources. California Data Exchange Center. 1992.

DEPARTMENT OF WATER RESOURCES
CALIFORNIA DATA EXCHANGE CENTER

SNOW COURSE # 428 -- LOWER BIG DRAW

SANTA ANA R

3-LETTER ID: LBD
ELEVATION: 9600 FEET
NO. OF SAMPLE POINTS: 10
AVG APRIL 1 WATER CONTENT: 15.3"

LATITUDE: 34D 6' 42"
LONGITUDE: 116D 50' 18"
RECORD BEGAN 1984
ASPECT:

MEAN DEPTHS AND WATER CONTENTS ARE IN INCHES																		
YEAR	JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE/SUPPLEMENT		
	DATE	DEPTH	WC	DATE	DEPTH	WC	DATE	DEPTH	WC	DATE	DEPTH	WC	DATE	DEPTH	WC	DATE	DEPTH	WC
1984							2-29	21.2	9.3	3-25	11.6	5.5	5- 5	7.3	3.3			
1985				1-27	55.5	19.9	3- 1	66.9	23.4	3-30	59.8	25.1	4-26	42.1	21.4			
1986				2- 2	45.2	18.5	3- 9	39.1	16.5	4- 5	55.1	26.1						
1987										4-13	46.4	17.8						
1988				2- 5	50.9	15.8				3-29	28.3	11.6	5- 3	.0	.0			
1989													5- 3	.0	.0			
1990				2- 2	27.0	6.8	2-28	38.4	8.7	3-30	34.2	14.0	5- 1	7.4	2.9			
1991				1-30	22.8	7.1	2-27	14.1	5.0	4- 3	98.0	29.0	4-29	68.3	31.5			
1992				1-29	34.0	10.5	2-26	75.4	23.2	3-30	96.0	33.8	5- 4	52.4	22.1			

TABLE 2. SNOW SURVEY DATA: Lower Big Draw.
Department of Water Resources. California Data Exchange Center. 1992.

of the Mojave Desert. Geologically, it is considered part of the Mojave crustal block and, before uplift, was part of the Mojave Desert during Tertiary and early Quaternary time. Separated from the north block by the San Andreas fault system, the south block is primarily eroded from a gneiss and is similar to the rocks of the San Gabriel Mountains to the west, but unlike the rocks of the north block. The south block is divided into two slices by a diagonal branch of the San Andreas fault: the northeast slice is mountainous and contains Cenozoic sedimentary strata, while the southwest slice has low relief and no Cenozoic strata (Dibblee 1976).

The southwestern portion of the north block, in the Mount San Geronio area, which includes the site of the Horse Meadow candidate Research Natural Area, has been uplifted as several north-tilted blocks. This young upland area was rapidly uplifted and its old eroded surface is being quickly dissected into deep and rugged canyons. The South Fork river canyon is a typical example of the topography of this crest region and the steep slopes of the candidate Research Natural Area are characteristic of this area of rapid uplift. This uplift was not continuous but elevated the great block that is known as the San Bernardino Mountains in progressive stages, with periods of rest. The range has reached such a great height that, although the general climate of the region is arid, the mountains intercept the moisture in the upper atmosphere and receive a precipitation near to that of a humid area. Glaciers once occurred along the north side of the crest, but disappeared as the climate became milder (Vaughan 1922). Evidence of these glaciers is found at the Horse Meadow site.

Most of Horse Meadow is composed of undifferentiated gneissic rocks of Precambrian age (Map 7: Geologic Map). Dibblee (1964) notes that these gneissic rocks, richly banded or laminated with feldspar, were formed at great depth by extreme recrystallization as early as Precambrian or as late as Mesozoic times from sedimentary, or in part from volcanic rocks, of Precambrian age. The light- to dark-gray gneiss ranges from laminated gneiss to gneissoid quartz diorite and is the most extensive rock type at the Horse Meadow candidate Research Natural Area. This gneiss overlays the widespread granitic rocks, the most common rock type of the San Bernardino Mountains. This fine- to coarse-grained gneiss is composed of plagioclase (andesine), quartz, potassic feldspar, and hornblende in general order of decreasing abundance.

Other geologic materials occupy small portions of Horse Meadow within the boundaries of the proposed Research Natural Area. Near the top of the steep primarily north-facing slope above San Y Ca Spring, a small area of quartz monzonite occurs. This plutonic rock is of Mesozoic age and is described by Dibblee as a gray-white, generally massive, medium-grained quartzite composed mainly of quartz, potassic feldspar, and plagioclase (oligoclase) in generally equal proportions. The relationship of this outcropping to the extensive granitics of the San Bernardinos is revealed by a vertical transect done by Dibblee that fortuitously crosses the Horse Meadow site (Map 8. Vertical Geology of Horse Meadow Candidate RNA). In this map, the gneissic rocks are shown as an unconformity overlying a granitic base. The quartz

monzonite on the Horse Meadow slope, then, is a relatively small outcropping of the extensive underlying granitic rock.

Due north of the Dollar Lake Trail and inside the site boundary line, a small area of glacial till occurs. This glacial till extends to the south beyond the proposed southern boundary line and is identical to the glacial till above and around Dry Lake (outside the site). These unsorted angular gneissic or granitic rocks are as large as 10 ft. (3.05 m) across and were deposited by glacial ice during the last ice age (Dibblee 1964; Sharp et al 1959). At the extreme north end of the site, near the Poopout Hill Road, along the eastern boundary, and up an avalanche chute filled with bush chinquapin, small areas of fanglomerate occur. Like the glacial till just discussed, this slightly consolidated alluvial deposit derived from pre-Tertiary rocks of adjacent mountains. Deposited as an alluvial fan, this surficial sediment is composed of unsorted boulders, cobbles, pebbles, and sand derived mostly from gneiss and quartz monzonite. Outside the candidate RNA, in the Barton Flats area, these sediments are as thick as 300 feet.

Dibblee (1964) maps a concealed fault right along or just to the east of the proposed eastern boundary. Horse Meadow candidate RNA is (perhaps obviously) on the upthrown block of the fault. Morton et al (1980) do not show this fault on their more recent geologic map of the San Geronio Wilderness (Map 9: Geologic Map of the San Geronio Wilderness), although a single fault is shown-- far distant from the site-- on the map. This map, however, illustrates in more detail than Dibblee the strike and dip of foliation on the gneissic rocks of Horse Meadow candidate RNA.

SOILS

Detailed soil inventories of the Horse Meadow Area are not available. Although the USDA Soil Conservation Service has completed detailed maps of the southwestern part of San Bernardino County (Woodruff and Brock 1980), the San Bernardino National Forest lands form the northern and eastern boundaries of the survey and are unmapped. However, the US Forest Service has released a draft version of an Order 3 Soil Resource Inventory (SRI) for the San Bernardino National Forest (Retelas 1980). This reconnaissance inventory was compiled to provide forest-wide information. Because most soil types were mapped by photo-interpretation and little ground-truthing was included in the inventory process, the resolution of the mapping was very low (that is, the minimum mapping area is about 100 acres or 40 ha). This SRI is not suitable for site-specific planning for Horse Meadow. Nonetheless, this inventory is the best information available at this time and is included here to aid subsequent researchers (Map 10: Soil Map).

The proposed Horse Meadow Research Natural Area is mapped as four different soil types. A deep, well drained alluvial soil, the Morical and Hecker families complex (BoE), occurs at the north end of the site at lower elevations and above the South Fork trail at the

eastern boundary. This complex occurs on alluvial fans or terraces with moderate relief (15 to 30 percent slope). These soils are brown gravelly loams with a granular, or fine granular, structure. The surface soils are 0" to 6" (0-15 cm), but the subsoils are very deep, ranging from 6" to 60" (15-150 cm), and have weathered from granitic or metamorphic rocks. The effective rooting depth is 40" (100 cm). Jeffrey pine-fir forest is the typical vegetation for this soil type.

In the vicinity of San Y Ca Spring and stretching to the southeast, an expanse of moderately deep to deep, well-drained (sometimes excessively so) soils characteristic of mountainous uplands in the San Bernardino Mountains occurs. These soils, the Merkel-Wapal families complex (FbF), are derived from metamorphic or granitic substrates and occur on 30-50% slopes. These light- to dark-brown, very gravelly loams are soft with a weak to fine granular structure. The surface soils are 0" to 3" deep (0-7.5 cm) and the subsoils range from 3" to 27" (7.5-68 cm). The effective rooting depth is 20-40" (50-100 cm). Jeffrey pine-fir forest, southern California white fir forest, and southern California subalpine forest are the typical vegetation types for this soil complex in the San Bernardino Mountains.

On the mid to upper north facing slopes above San Y Ca Spring and Poopout Hill, deep and excessively drained sandy soils weathered from granitic rocks are found. This Wapal family- lithic xerorthents, cool association (WpG) occurs on very steep slopes (50-75%). This soil is typical of mountainous uplands and usually includes a high percentage of rock outcrops. The soil is a light olive brown, very gravelly, sandy loam with a fine granular structure. About 20% of the soil is a sandy loam with up to 80% rock fragments. The surface soils are 0" to 3" (0-7.5 cm) and the subsoils are rather shallow, ranging from 3" to 20" (7.5-50 cm) in rocky areas and 3" to 40" (7.5-100 cm) where the Wapal family predominates. The effective rooting depth is 20-40" (50-100 cm). Erosion hazard for this soil type is high to very high. White fir forest is the typical vegetation for this soil type.

Finally, the southern half of the site is mapped as a shallow, excessively drained soil, the Lithic Xerorthents, cool - Rock outcrop complex (LdG), that occurs on extremely steep slopes (50-100%). This soil is formed in material weathered from granitic, metamorphic or limestone rocks. A loam, sandy loam or loamy sand with a high proportion of rock fragments constitutes 50% of this soil complex; rock outcrops of bare bedrock with small inclusions of soil where plants can root, make up another 30%. Areas of rubble land are also included in this soil unit. The effective rooting depth is less than 20" (50 cm) and the erosion hazard is very high. Lodgepole pine and jeffrey pine, components of the southern California subalpine forest and the jeffrey pine-fir forest, are the typically dominant trees on this soil type.

III. BIOLOGY

THE VEGETATION OF HORSE MEADOW

In 1975, Cheatham and Haller described a system of "natural communities" of California's landscape; this system has been revised several times by the California Natural Diversity Data Base. More recently, Holland (1986), working together with biologists knowledgeable about particular areas and community types, prepared a preliminary draft of the terrestrial natural communities of California. This listing of plant community types not only names the community, but describes the components of the vegetation, including characteristic species, site factors and geographic range.

Following Holland (1986), Horse Meadow candidate RNA contains several community types (Map 11: Vegetation Map of Horse Meadow candidate Research Natural Area). The site is predominately a Southern California White Fir Forest (Element Code 85320) on the northeast and north-facing slopes where the snow lies late in the year. At higher elevations, the white fir forest is replaced by Southern California Subalpine Forest (Element Code 86500), which grades in some locations into pure stands of Lodgepole Pine Forest (Element Code 86100). The steep slopes of the Horse Meadow RNA are dissected by several avalanche slopes that are densely vegetated with Mixed Montane Chaparral (Element Code 37510), dominated by either *Ceanothus cordulatus* or *Chrysolepis sempervirens*. A Jeffrey Pine-Fir Forest (Element Code 85210), described in other publications as a Western Coniferous Forest (Minnick 1976) or Mixed Conifer Forest, occurs along the gentle slopes near the South Fork Trail at the eastern boundary of the Horse Meadow candidate RNA. Along the edges of creeks, Southern Willow Scrub (Element Code 63320) occurs in relatively small patches in particularly mesic sites. Where the water table is high and the terrain level, Montane Meadow (Element Code 45100) occurs in scattered patches in the Jeffrey Pine-Fir Forest. A summary of the extent of each vegetation type is included in Table 3, which follows this section.

SOUTHERN CALIFORNIA WHITE FIR FOREST (Element Code 85320)

The southern California white fir forest is the most extensive vegetation type at Horse Meadow candidate Research Natural Area. White fir (*Abies concolor*) occurs here as nearly pure stands or in stands where dominance is shared with *Pinus jeffreyi* or *Pinus flexilis* and *Pinus contorta* ssp. *murrayana*. This is a dense and dark forest and tree cover is usually between 80-100%. Jeffrey pine is the typical co-dominant on the drier, more gentle, mid-elevation slopes that face to the northeast. Lodgepole pine and limber pine share up to 50% dominance on steep slopes at high elevations. On true north-facing slopes, however, *Abies concolor* often accounts for nearly 100% of the tree cover. On high and steep unstable slopes, the white fir occurs in dense stands of small trees; the trees often show a pronounced basal crook, probably due to sliding soils. The white fir forest of the mid to upper slopes of Horse

Meadow is a young forest; mature stands or large individual trees are uncommon on these steep, shallow, and unstable soils. Around rock outcroppings high on the north-facing slopes, however, the soil is stabilized enough that *Abies concolor* can reach great sizes.

As is typical of the vegetation type, the understory of the white fir forest of Horse Meadow is sparse or even absent. In the soft dark sandy and gravelly soils of the upper slopes, only a few widely scattered herbaceous plants are found. Typical associates include *Pedicularis semibarbata*, *Poa fendleriana*, *Penstemon bridgesii*, *Penstemon labrosus*, *Draba corrugata* and *Pyrola picta*. At lower elevation and drier sites, where jeffrey pine co-dominates, *Symphoricarpos parishii*, *Eriogonum wrightii* spp. *subscaposum*, and *Galium* cf. *nuttallii* occur. At the higher elevation sites, *Ribes roezlii*, *Phyllodoce breweri*, *Pyrola picta*, *Poa fendleriana*, *Heuchera* sp., and *Sedum spathulifolium* spp. *andersonii* occur as herbaceous associates of white fir, lodgepole pine, and limber pine. Scattered montane chaparral shrubs (*Chrysolepis sempervirens*, *Arctostaphylos patula* spp. *platyphylla*) occur both as occasional understory associates and as a distinct shrubby vegetation type in forest openings.

As is typical of white fir in southern California, this forest dominates the mid and upper north- and northeastern-facing slopes at Horse Meadow candidate RNA. Percent cover of lodgepole pine and limber pine increases as elevation increases and the white fir forest grades into lodgepole pine or southern California subalpine forest along the upper ridge and at the southern end of the site.

SOUTHERN CALIFORNIA SUBALPINE FOREST (Element Code 86500)

A subalpine pine forest, dominated by *Pinus contorta* ssp. *murrayana* and *Pinus flexilis*, covers the high elevation ridges at the Horse Meadow candidate Research Natural Area. In this forest, limber pine, *Pinus flexilis*, is most important on exposed ridges and high slopes. The southern California subalpine forest, which may include small stands of either co-dominant pine in nearly pure stands, occurs at higher, drier, colder sites than typical for the white fir forest. Although this forest is often a low krummholz at timberline in the San Bernardino Mountains, here the trees occur in upright, relatively dense stands. This subalpine forest generally occurs on dry, rocky ridges that are subject to high winds in the winter. Growth is concentrated in early summer as summer drought and low temperatures from fall through spring limit growth during the rest of the year. This forest grades into areas of lodgepole pine forest (Element Code 86100), where *Pinus flexilis* drops out completely. The lodgepole pine forest is not mapped separately, as it was impossible to distinguish from the southern California subalpine forest from aerial photographs or during brief field visits.

In both these forest types, the understory is sparse. The slopes characteristic of these forests are very steep and rocky and the ground is mostly bare except for a pine needle duff over the soft, powdery soil. On these dry hillsides, the gravelly unstable slopes have patches of pure *Chrysolepis sempervirens*, and scattered herbaceous plants, including *Carex* spp., *Penstemon caesius*, *Phyllodoce breweri*, *Pyrola picta*, *Pedicularis semibarbata*, and *Silene*

lemmonii throughout the forest. In hollows where the snow lies late-- providing water into the growing season-- and where the forest is relatively open, perennial herbs can occur abundantly. These bright green patches in the middle of the forest have up to 100% herbaceous cover and include *Pteridium aquilinum*, *Ribes montigenum* var. *pubescens*, *Aquilegia formosa*, and *Carex* spp.

This vegetation type is confined to the highest peaks in southern California, including Mt. Baden-Powell and San Antonio Mountain in the San Gabriel Mountains; Mt. San Jacinto in the San Jacinto Mountains, and, most abundantly, here in the vicinity of Mt. San Gorgonio in the San Bernardino Mountains.

JEFFREY PINE-FIR FOREST (Element Code 85210)

On the more gentle, lower slopes of the Horse Meadow candidate Research Natural Area, a jeffrey pine-fir forest occurs. This forest is variously known as a mixed conifer forest or a western coniferous forest. In this tall, open forest, the tree layer is co-dominated by *Abies concolor* and *Pinus jeffreyi*. Tree cover ranges from about 50-80%. Occasionally, as on the nearly level slopes of the far northern area of Horse Meadow candidate Research Natural Area, black oak (*Quercus kelloggii*) is an important component of the vegetation. The jeffrey pine-fir forest occurs along the South Fork Trail and grades upslope into a white fir forest.

On steeper, drier slopes, the understory is scattered and includes *Symphoricarpos parishii*, *Chrysolepis sempervirens*, *Ceanothus cordulatus*, *Carex* spp., *Penstemon labrosus*, *Euphorbia palmeri*, *Eriogonum wrightii* spp. *subscaposum*, and *Leptodactylon pungens*. In rocky, open areas at low elevations, understory associates account for about 5% cover and include *Erysimum capitatum*, *Poa fendleriana*, *Penstemon grinnellii* ssp. *grinnellii*, *Sitanion hystrix*, and *Symphoricarpos parishii*. In moister areas *Pteridium aquilinum*, *Achillea millefolium*, *Potentilla glandulosa*, *Geranium richardsonii*, *Erigeron breweri*, *Solanum xantii* spp. *montanum*, and various grasses may occur. Where black oak is an important dominant, or near riparian washes, *Salix scouleriana*, *Ribes cereum*, and *Ceanothus cordulatus* are associated shrubby species. Herbaceous species include *Gayophytum diffusum* spp. *parviflorum*, *Castilleja martinii* var. *martinii*, *Delphinium parryi*, *Lotus nevadensis*, *Lupinus formosus*, and *Bromus* sp. *Calochortus invenustus* is a particularly beautiful associate, occurring here as a lovely ivory white flower with a pale green streak on the back of each petal. The flowers are held aloft on tall delicate stems and sway gently with each passing breeze.

This abundant vegetation type is found south from Mt. Lassen on the west side of the Sierra Nevada, in scattered locations on the east side of the Sierra Nevada, and in the higher portions of the transverse ranges of southern California.

MIXED MONTANE CHAPARRAL (Element Code 37510)

Species typical of mixed montane chaparral, including *Ceanothus cordulatus*, *Ribes cereum*, *Chrysolepis sempervirens*, and *Arctostaphylos* spp., are found as common shrubby associates of the forest types discussed above. However, at Horse Meadow candidate RNA, they also occur as dense, heterogeneous, nearly impenetrable thickets in areas that are known or believed to be avalanche chutes. Typically, this chaparral is dominated by a single species and forms a nearly closed canopy. Understories are very sparse and associated species are few.

Minnick (pers.comm) has speculated that the *Ceanothus cordulatus*-*Ribes cereum* chaparral at the northern end of the candidate RNA may be the site of a burn. Here, a trail crosses the chaparral and associated species at the edge of the disturbed *Ceanothus* patch include *Artemisia dracunculus*, *Gayophytum diffusum* ssp. *parviflorum*, *Cryptantha* spp., *Euphorbia palmeri*, *Sitanion hystrix*, *Bromus* cf. *tectorum*, and *Agropyron trachycaulum*. Presumably, these species occur in other open areas within the patch that were not visited due to the difficulty of moving through this thorny sclerophyllous vegetation.

Further to the south, two other widespread areas of mixed montane chaparral occur on the northeast-facing slopes and are dominated by the bush chinquapin, *Chrysolepis sempervirens*. These bush chinquapin slopes are presumed to be avalanche chutes and reach to the high elevation upper slopes of the Horse Meadow candidate RNA, cutting through the subalpine, white fir, and the jeffrey pine-fir forests.

MONTANE MEADOW (Element Code 45100)

In clearings and in level areas along streams in the jeffrey pine-white fir forest, a rich assemblage of herbaceous plants forms a dense green montane meadow. Slopes are nearly level or gentle (generally between 5-15%) and soils are generally saturated. *Salix lasiolepis* and *Salix scouleriana* often form tall thickets right at the edge of the stream; *Pteridium aquilinum* fringes the meadow where it grades into the dry forest. *Poa palustris* and *Carex hoodii* are abundant, each accounting for 25-40% cover in the meadow. *Verbascum thapsus*, *Sphenosciadium capitellatum*, *Juncus mertensiana*, *Epipactis gigantea*, *Mimulus breweri*, *Sisyrinchium idahoense*, *Mimulus guttatus* ssp. *guttatus*, *Veronica americana*, and *Castilleja miniata* are among the many associated plants. At Horse Meadow candidate RNA, as throughout the range of this vegetation type, montane meadows are scattered throughout the site, occurring in relatively small patches along waterways wherever the soil moisture stays high.

Nowhere in the Horse Meadow candidate Research Natural area are willow thickets particularly extensive, but where they occur, as depicted in the montane meadow discussion above, they are best described as a southern willow scrub, a vegetation type described by Holland. However, as these thickets are in close association with the montane meadows and do not cover significant acreage, they are not considered separately. Although Holland lists similar dominants (*Salix lasiolepis*, *Salix scouleriana*), the southern willow thicket he describes

refers to the once widespread riparian vegetation that was once so typical along the gravel bars of large southern California rivers.

TABLE 3. Extent of the Vegetation Types of Horse Meadow, San Bernardino County.

These acreage estimates are based on the Vegetation Map (Map 11) of Horse Meadow. As noted in the text, several of the vegetation types intergrade with one another. No attempt was made to account for these inclusions of other types within the widespread typical vegetation type.

Southern California White Fir Forest	376 acres (150 ha)
Jeffrey Pine-Fir Forest	162 acres (65 ha)
Southern California Subalpine/Lodgepole Forest	170 acres (67 ha)
Mixed Montane Chaparral	239 acres (96 ha)
Montane Meadow	not mapped separately, intergrades with all other vegetation types except Mixed Montane Chaparral

VEGETATION SAMPLING AT HORSE MEADOW

In 1989, Dr. Andrew Sanders, along with an assistant, Jennifer Lyman, sampled the vegetation at Horse Meadow. Three belt transects, each 100 m long and 10 m wide, were established on the site in areas where access was reasonable. Once a general area was selected for sampling, a randomly selected compass bearing was used to set the transect location. Each 1000 m transect was sampled with 10 subplots (10 m X 10 m) in order to measure the amount of variation in the vegetation at the sampling site.

The name of each species occurring within each subplot was recorded. In the herbaceous layer, all plants were simply recorded and counted. For woody species, such as trees and shrubs, the height was measured, as well as dbh (for tree species) and two diameter measurements of the crown. Crown cover is calculated by the "Crown-Diameter Method", using the formula $cc = (\text{Diameter 1} + \text{Diameter 2} / 4)^2$. The first diameter measure was taken at the longest axis of the crown; the second, at a right angle to the first measurement.

Cover is usually defined as the vertical projection of the crown to the ground surface and is generally expressed as a percent of the total sampling area. Cover is considered to have greater ecological significance than density, as it gives a better measure of plant biomass than does the number of individuals. Mueller-Dombois and Ellenberg (1974) emphasize the importance of plant biomass to community analysis when they note:

Plant biomass has a major influence on the stand climate in terms of light and temperature relationships. It influences the water relations through rainfall interception and transpiration rate per unit area, and it is closely related to the volume of circulating nutrients in the ecosystem. Moreover, the amount and

characteristics of the plant biomass are of direct importance to the animals associated with the vegetation, because the plant biomass provides their shelter and food.

Computer analysis of the transects, calculating percent cover for the dominant species, are presented in Table 4.

Transect Descriptions

SITE 1. This is a relatively dense white fir forest, with 67% total cover. *Abies concolor* accounts for nearly half of the plant cover, but is associated here with *Pinus contorta* ssp. *murrayana* and *Pinus flexilis*, two tree species associated with exposed high elevation sites. *Chrysolepis sempervirens* is a typical shrubby associate and contributes almost 10% cover at this transect. *Pyrola picta*, *Carex* sp., *Draba corrugata*, *Poa fendleriana*, and *Penstemon labrosus* occur here in the sparse understory of this dark forest.

SITE 2. No field notes on the general aspect of this transect are available, other than a marginal note that the upper half of the plot is all granitic rubble. This very open site, perhaps a steep, arid opening in the white fir forest, has very low cover, 4.74%. *Ribes roezlii*, a common shrubby associate of the white fir forest, contributes more than half of this cover. Small specimens of *Abies concolor*, *Pinus contorta* and *Pinus flexilis* are numerous at the site, but contribute very little cover. Associated herbaceous plants include *Sedum spathulifolium* ssp. *anomalum*, *Heuchera* sp., *Pyrola picta*, and *Carex* sp.

SITE 3. This dense jeffrey pine-white fir forest (71% cover), located near a riparian area, had much fallen timber, mostly white fir. Older trees showed burn marks on the uphill side. Soils at this plot are a very thin and rocky schist. *Abies concolor* contributes half of the total cover (49.9%), but *Pinus jeffreyi* is a significant associate with 16.5% cover. The shrub layer is dominated by *Chrysolepis sempervirens* and *Arctostaphylos patula*, that together cover almost 5% of the transect. *Symphoricarpus parishii*, *Penstemon labrosus*, *Leptodactylon pungens*, *Poa fendleriana*, and *Galium* sp. are frequent understory associates.

TABLE 4. Summary Table of Sander's Horse Meadow Transects, June 1989.

	Site 1	Site 2	Site 3
LOCATION	unknown for all three transects.....		
OBSERVERS	Lyman and Sanders	Lyman and Sanders	Lyman and Sanders
DATE OF FIELD WORK	Summer 1989.....		
PLOT SIZE	1000 m sq.	1000 m sq.	1000 m sq.
TOTAL PLANT COVER	667.08 m sq.	47.40 m sq.	713.39 m sq.
PERCENT COVER	67%	5%	71%

The following information summarizes the percent cover information for the species which have the highest percent cover in the transects.

SPECIES NAME

<i>Abies concolor</i>	45.53%	1.00%	50.0%
<i>Pinus jeffreyi</i>	-	-	16.50
<i>Pinus contorta</i>	5.94	0.34	1.06
<i>Pinus flexilis</i>	5.50	+	-
<i>Chrysolepis sempervirens</i>	9.72	0.01	3.66
<i>Ribes roezlii</i>	-	3.36	-

SENSITIVE PLANT SPECIES OF HORSE MEADOW

Although they have no formal state or federal status, three plants found at Horse Meadow candidate Research Natural Area are listed by either the US Forest Service, the California Native Plant Society, or the California Natural Diversity Data Base as sensitive or "special" plants. The California Native Plant Society (CNPS) lists the Barton Flats horkelia, *Horkelia wilderae*, on List 1B: "Plants Rare, Threatened or Endangered in California and Elsewhere". This horkelia is reported to be relatively common and not threatened within the San Bernardino Mountains (Neel, pers. comm.), but it is considered threatened and endangered in some parts of its range. The CNPS R-E-D code (Rare-Endangerment-Distribution) is 2-2-3; that is, occurrence is confined to several populations; the species is endangered in a portion of its range; and the species is endemic to California. At Horse Meadow, *Horkelia wilderae* was noted on northeastern-facing dry slopes of the jeffrey pine-fir forest. This plant is reported to have a large discontinuous population that occurs in lower and upper montane coniferous forests, on rocky north-facing benches or slopes between 6000-8000 ft. (1800-2400 m) where snowdrift persists late into the year.

The mountain dandelion (*Taraxacum californicum*), sometimes known as the California dandelion, was found by Sanders in wet montane meadows at the Horse Meadow candidate Research Natural Area. Unlike the introduced European weedy species, the light green, glabrous mountain dandelion has erect outer phyllaries and nearly entire toothed or wavy-margined leaves. This species is typically found in mesic meadows that are free of taller vegetation, between 6700-9000 ft. (2050-2750 m). The California Native Plant Society lists the mountain dandelion, *Taraxacum californicum*, on List 1B: "Plants Rare, Threatened or Endangered in California and Elsewhere". This native dandelion is reported to be relatively common and not threatened within the San Bernardino Mountains (Neel, pers. comm.), but it is considered threatened and endangered in some parts of its range. The CNPS R-E-D code (Rare-Endangerment-Distribution) is 2-2-3; that is, occurrence is confined to several populations; the species is endangered in a portion of its range; and the species is endemic to California.

The third sensitive plant, *Castilleja montigena* [syn. *C. martinii* var. *ewanii*], Heckard's Paintbrush, has been included by CNPS on List 4: Plants of Limited Distribution, the so-called "watch list". This plant is endemic to the San Bernardino Mountains between 5000-9000 ft. (1525-2745 m) and is typically found in clay openings on either pebble plains or in the forest-meadow ecotone of upper montane coniferous forest. *Castilleja montigena* was recorded by Sanders in the 1989 survey of the Horse Meadow candidate RNA. This recently described Indian Paintbrush (Heckard et al 1980) was not collected during the most recent survey (1991).

The Natural Diversity Data Base supplied Map 12: Known Populations of Sensitive Plants in the Horse Meadow Area. Note that the Ash-grey Indian Paintbrush (*Castilleja cinerea*) occurs nearby, but has not been found within the proposed RNA boundaries.

FAUNA OF HORSE MEADOW

No detailed studies of the fauna of Horse Meadow are available. Lists of amphibians, reptiles, birds and mammals that may occur on the site are available upon request from the Forest Wildlife Biologist at San Bernardino National Forest Headquarters. Using the Statewide Wildlife Habitat Relationship System (Timossi 1989), a database system originally programmed for Pacific Gas and Electric and now maintained by the State of California Department of Fish and Game, it is possible to "filter" the names of the wildlife that may occur at a particular site by carefully listing the physical and biological characteristics of the site. It is, however, essential that an experienced wildlife biologist review the list for obvious errors of inclusion or exclusion. I am grateful to Mr. Steve Loe for the list that appears as Appendix C: Predicted Wildlife Species of Horse Meadow: A Preliminary Checklist. The list generated by the database based on the site characteristics I submitted was reviewed by Loe and many unlikely species were eliminated based on species information included in "California's Wildlife, Volumes 1-3" (Zeiner, et al 1988). The presence of these species should be verified by subsequent ground surveys.

The Mill Creek Ranger Station has recently organized an interdisciplinary team headed by Rose Robinson (Fish Biologist) and Steve Loe (Forest Wildlife Biologist) to study the wildlife and vegetation of Horse Meadow, the meadow-forest complex north of the Horse Meadow candidate RNA site. Although this study area is completely outside the proposed RNA boundaries, this team will be conducting a biological evaluation and wildlife survey that will be of interest to researchers in a nearby RNA. However, at this date, there is no information available to include in this report.

Dr. Bill LaHaye, a biologist surveying spotted owls in the San Bernardino Natural Forest, noted the territory of the spotted owl (*Strix occidentalis* ssp. *occidentalis*), a Forest Service Sensitive Species and a California "species of special concern" as occurring along the proposed northern boundary of the candidate RNA (Map 13). As one of the most heavily used wilderness trails in North America already is established in this area, it is unlikely that the establishment of an Research Natural Area will adversely affect the species; instead, the presence of these birds nearby enhances the value of establishing of an RNA in this area. The Williamson's sapsucker and Lincoln's sparrow are other bird species of interest that may occur on the site. These are species that are believed to be in decline. Suitable habitat for these birds exists within the proposed RNA (Sferra, pers.comm.).

Bighorn sheep (*Ovis canadensis*) are a species of interest that occur near the proposed candidate RNA. In the early 1970's, a study on the population, distribution, habitat, and reproduction of bighorn in the San Gabriel and San Bernardino Mountains was conducted (Weaver et al 1972). The range of a herd of bighorn, the San Gorgonio herd, extends to just outside the candidate Research Natural Area (Map 14). The population of the San Gorgonio herd at that time was estimated to be 115 bighorn. Bighorn sheep summer ranges are confined

to rugged and relatively inaccessible rocky habitats at high elevations. As noted in the map, the intermittent range of the San Gorgonio bighorn approaches the southern and western boundaries of the proposed Research Natural Area. Sheep are infrequently seen in these areas. Because of the habitats the bighorn frequent, it is highly unlikely the bighorn will ever use the heavily forested subalpine and white fir slopes of the Horse Meadow candidate Research Natural Area. Another mammal of interest, the state-listed San Bernardino flying squirrel (*Glaucomys volans*), may occur in this area as it is found not too far from this site (Sferra, pers.comm.). Two reptiles of interest have been reported from outside the proposed RNA site and may occur in similar habitats at Horse Meadow candidate RNA. The southern rubber boa (*Charina bottae umbratica*), restricted to the San Bernardino Mountains, has been found 5 miles (8 km) up Fish Creek, 8 miles (13 km) east of Barton Flats. This snake is found in a variety of montane forest habitats, especially in the vicinity of streams or wet meadows as it requires loose, moist soil for burrowing. It often seeks cover in rotting logs. The San Diego Horned Lizard (*Phrynosoma coronatum blainville*), typically a coastal sage scrub species, was collected at 6200 ft. (1885 m) by Grinnell in 1908 near the mouth of the South Fork of the Santa Ana River.

The headwaters of the South Fork Santa Ana River, just outside the proposed RNA boundaries, may contain an introduced population of Lahontan cutthroat trout, a threatened species. This fish was once incorrectly thought to be another species, the so-called San Gorgonio trout. No information was found regarding its present status in the South Fork; however, establishment of an RNA nearby would not be likely to affect a trout population in a nearby stream.

IV. LAND USE

PREHISTORIC LAND USE OF THE SAN BERNARDINO MOUNTAINS

The earliest known population to inhabit the San Bernardino Mountains were a native people who were given the name *Serrano*, or "mountaineer", by the Spaniards. This tribal people are classified by ethnographers as members of the Southern California branch of the Shoshonians. In the mountains, the Serranos settled on a semi-permanent basis in large villages near reliable sources of water and within gathering range of the plants and wildlife that the people depended upon. Three Serrano village names are reported from the Big Bear area: Yuhaviat ("Pine Place"), Kayahpiat, and Achavat. Seasonal camps were also established and used by Serranos during the harvest times of their important plant foods, which included chia seeds, acorns, and pinyon nuts. Numerous grinding stations are reported from these satellite camps. There is some evidence that these mountain villages may have been occupied year round. In addition to these permanent villages, however, foothill clans are known to have visited the mountains seasonally, probably for hunting and pinyon and acorn harvest. (various sources cited in Robinson 1981).

The Serranos were hunters and gatherers and followed a seasonal cycle of harvest from springtime gathering of tubers and greens, summertime seed collection, and fall pinyon and acorn harvests. Although more than 200 plants were used for food and medicinal purposes, the primary plant foods for the Serrano were acorns, pinyon nuts, and seeds from chia, buckwheat and sage plants. Deer, mountain sheep, rabbits and other small mammals were hunted by the men of the villages and this meat supplemented the plant foods gathered by the women. Food-gathering trails, hunting trails and trading routes crisscrossed much of the San Bernardino Mountains, including the ancient Mohave trail, and allowed travel within the mountains as well as trade between desert Indians and the peoples of the mountains and coastal plains beyond. In addition to the Serranos, the Wanakik (or Pass) Cahuilla people lived south of San Gorgonio Mountain, in the region of today's San Gorgonio Pass.

Although these native peoples ventured far up the mountain canyons and over some ridges, there is no evidence that they visited the high timberline country around San Gorgonio Mountain (Robinson 1991). A extensive archeological survey of the San Gorgonio-San Bernardino ridge found no chippings, bedrock mortars, charcoal soil, or other signs of early visits (Autier 1967). However, the mountain did have a special significance for native peoples of southern California, figuring into their creation myths and other tribal legends.

HISTORIC LAND USE OF THE SAN BERNARDINO MOUNTAINS

The first recorded European to have reached the San Bernardino Mountains was a Spanish soldier, Pedro Fages, who in 1772 pursued army deserters across the mountains and into

Finally, in the early 1960s, commercial skiing interests waged a nearly successful battle to open up the San Gorgonio crest region for ski, resort and other recreation interests. A group of conservationists, including Harry James, formed the "Defenders of the San Gorgonio Wilderness" association and fought to have the region designed as a National Wilderness Area. This issue reached an explosive head in Congress in the summer of 1964 when it was proposed that 3500 acres (1400 ha), including the proposed RNA site, be removed from the San Gorgonio Wild Area in order to allow ski development. By September, 1964, however, President Lyndon Johnson signed into law a new Wilderness Act that promised to "secure for the American people of present and future generations the benefits of an enduring resource of wilderness." Thus, the San Gorgonio high country region was set aside as a wilderness "where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain." In 1967, ski interests made one more fruitless attempt to open up the area for development, but, in the face of the opposition from local congressmen, the proposed bill died in the House Interior and Insular Affairs Committee.

The actual Horse Meadow, an open level site north of the proposed RNA, was used as a pack station and administrative headquarters for the US Forest Service until 1984. A corral and structure are still in place, but eventually will be removed. In 1989, to protect the fragile meadow habitats of South Fork Meadow and to enhance the use of other attractive areas in the San Gorgonio Wilderness, the South Fork Trail was re-routed. Records of the old trail, the proposed plans for trail re-routing, and the resulting public comment are on file at the San Gorgonio Ranger District Headquarters.

IMPLICATIONS OF RECENT AND CURRENT USE AT HORSE MEADOW

The lands surrounding the candidate Research Natural Area are owned by the US Forest Service; at the proposed RNA site and to the south and west, they are managed as part of the San Gorgonio Wilderness. Despite predictions by developers that the high country would be accessible to only a few if set aside as a wilderness, interest in hiking and backpacking skyrocketed between 1960 and 1970. Records of the San Bernardino National Forest indicate that, in South Fork Meadows region alone, visitation increased from 12,000 people in 1960 to 62,000 people in 1970 (Robinson 1977). As the largest established wilderness area in southern California and only two hours travel from Los Angeles, this new Wilderness was badly impacted by the high number of visitors. The South Fork Meadow region, which includes the steep slopes of the Horse Meadow site as its southwestern boundary, received the greatest impact, as it contains three of the Wilderness's four major attractions: South Fork Meadow, Dollar Lake, and Dry Lake. In addition, trails through the region lead to the single most attractive feature of the Wilderness, the summit of Mount San Gorgonio (Thorton 1969). During the late 1960's, soil erosion, pollution of the air (by campfires) and the water (by improper sanitation), and overcrowding at popular campsites near water caused a continual

deterioration of the wilderness environment in the South Fork Basin.

In 1971, a Wilderness Permit system was instituted to protect the San Gorgonio Wilderness from overuse by too many visitors in wilderness campgrounds, trails, and backcountry (Robinson 1991). Although the permit system did not originally fix quotas, in 1973, the San Gorgonio Wilderness was divided into six zones and a maximum number of day hike and overnight camping permits were established for each zone. Because of the significant impact large organized groups such as the Boy Scouts and other clubs were having on the Wilderness and the wilderness experience, group size was limited to 15 persons and each group was required to camp at least 200 ft. away from any other group. In 1974, a special designation, the Explorer Permit, was established to encourage use of less visited regions of the San Gorgonio Wilderness. These permits allow the backpacker who has shown proficiency in map reading and cross-country travel to leave established trails and camp outside of established campsites.

The entire proposed Horse Meadow Research Natural Area is within the South Fork Zone (Permit Zone 1). The day hike quota on the South Fork Trail is 26 permits; 20 permits are available for overnight campsites. Because few people hike or backpack alone, permits are issued on the basis of groups, rather than individuals. Thus, the average expected overnight occupancy of the South Fork Zone is estimated at 130 (20 campsites X 6.5 people); maximum occupancy, based on largest allowed group size, may be as high as 300 (20 campsites X 15 people). The maximum day-use capacity of the South Fork Zone Trails (South Fork Trail and Dollar Lake Trail) is 390 people. The most recent figures available from the Mill Creek Ranger Station for the number of visitors to the South Fork Zone cover the period between March 1989 and August 1990. During these 18 months, 2276 overnight camping permits were issued and included 11,925 people; 3909 day-use hiking permits were issued to a total of 13,615 people. Thus, at least 25,540 people presumably walked along the Poopout Hill-South Fork Trail during this time.

Although easily accessible and bordered near the eastern edge by the South Fork Trail and the along the southern edge by the Dollar Lake Trail (as noted above, both intensively used trails), the Horse Meadow candidate RNA site is relatively free of disturbance. Hikers along the South Fork Trail tend to stay quite near the trail; few are likely to climb a very steep north slope that leads to no particular destination of interest. Walking the trails is by far the simplest route to the high country of the San Gorgonio Wilderness. Campsites occur outside the RNA in the vicinity of South Fork Meadow, but have only a local impact. The most significant current disturbance is near the northern boundary, near Road 1N78. In this relatively level open area of black oaks and white fir, there is clear evidence of illegal firewood gathering.

Air pollution is a significant hazard to the coniferous species of this area. Both short and long term studies are underway to identify and quantify the chronic effects of oxidant air pollutants in the mixed conifer forest, of which *Abies concolor* is an important element. The

San Bernardino National Forest has been exposed to an increasing annual dosage of photochemical oxidants during the last three to four decades as industrial and urban growth in the South Coast Air Basin has expanded at an explosive rate. The National Forest, located at the east end of the South Coast Air Basin, is subjected to an ebb and flow of polluted air from developed areas on the valley floor, as diurnal "pumping" of high desert air and marine air occurs in the Basin. In the morning, air flows from the east to the coastal regions and, as the day warms, marine air laden with oxidant pollutants is delivered to the San Bernardino National Forest (Taylor, O.C., ed. et al 1980). In the late 1950s, ozone damage to ponderosa pine (*Pinus ponderosa*) was first recognized. Other coniferous trees, including white fir, are also susceptible to damage from air pollutants.

In 1974, the Statewide Air Pollution Research Center established 18 plots in the San Bernardino National Forest to measure the relationship between tree growth and crown condition, as well as to conduct an analysis of succession of forest trees at these permanent plots. At each of these permanent plots, a 150 or 200 m centerline was established and all forest trees more than 4" (10 cm) in diameter and within 20 m of each side of the centerline were included in the study. The tree conditions are measured every August. A soil analysis is done as well. The permanent plots nearest the candidate Research Natural Area are near Barton Flats and at Heart Bar. Preliminary results of this study were published in 1980 (Taylor, O.C., ed.) in a very detailed form, but did not summarize the degree of damage each tree or forest type experienced. A more recent publication (Miller et al 1989) notes trends of ozone damage to coniferous forests during a 14 year period (1974-1988).

In addition to this longterm study, the California Air Resources Board recently funded a supplemental short-term study that established four new plots near the candidate Research Natural Area: one at Barton Flats, near the Visitors' Center; the other three are within one mile of Barton Flats (Miller, pers.comm). A meteorological station and pollution monitoring site was established at Barton Flats in September 1991; the site will be monitored through September 1994. In addition to tracking wind speed and direction, relative humidity, temperature, solar radiation and precipitation, this station gathers data on the dry deposition of nitrites, sulfates, and total particulate matter. The other three plots measure the response of vegetation to changes in air and water quality. Chemical analyses of both the air and water are conducted periodically. One plot includes a 94 ft. (28.67 m) tall scaffold that allows researchers to sample from the canopy of the forest trees. This research should give accurate information on local effects of air pollution in forest types quite similar to that at the Horse Meadow candidate Research Natural Area. The recent addition of a meteorological station at Barton Flats will give detailed climate data that can be extrapolated to some extent to the Horse Meadow site.

FIRE HISTORY

Although requested from the supervisor's office, no fire history maps of this area were received. However, all computerized records of recent fires were searched by the Mr. Jerry Wilke of the Supervisor's Office. Three fires are recorded since 1980 in the southwest quarter of Section 22, T1N, R1E: a 17 July 1980 1-acre fire, the "Chinook" fire started by equipment ; the 26 July 1980 lightening 1-acre "Coon" fire; and the "Jenks" fire, a 0.10 acre fire on 5 July 1989. It is not clear whether these fires are inside the proposed RNA boundaries or not; this quarter section also includes the actual Horse Meadow, a meadow-forest complex across Road 1N78 from the candidate RNA site.

Since the early 1900s, a policy of fire suppression has been in place in the San Bernardino Mountains. Researchers question whether the large canopy fires of recent decades are a product of fire management or a natural event. Some believe that stand-thinning fires are required to maintain viable forests. However, canopy fires did occur locally in southern California mountains (Minnick 1991, Minnick 1988). Thick stands of *Abies concolor* are highly flammable; Minnick (pers.comm.) speculates that some white fir stands at the candidate Research Natural Area are unnaturally dense as a result of fire suppression (as high as 40 stems per acre) and represent an extreme fire hazard.

The *Ceanothus-Ribes* patch at the north end of the Horse Meadow candidate Research Natural Area burned in approximately 1959. In the jeffrey pine-fir forest of the lower elevations at this site, the understory is now five times denser than is typical where groundfires are not suppressed (Minnick, pers. comm). Understory fuel levels are high for this forest type and it is likely that any fire in this area would soon lead to canopy fire.

V. RECOMMENDATIONS

RESEARCH NATURAL AREA BOUNDARIES

The boundaries on all the maps included in this report are essentially the same as those which accompanied the purchase order for this report. These boundaries form an area that is a coherent research unit, including an entire slope of white fir and associated habitats undissected by any trails. As noted earlier in this report, this site provides excellent access along trails, roads and, except for the areas dominated by mixed montane chaparral, easy travel through relatively rugged open terrain for researchers and their equipment. The boundary along the Poopout Hill Road (Road 1N78) might be pulled further to the south. However, the open black oak-white fir community that occurs here is of interest. If this road is eventually closed, as has been proposed by some managers of the wilderness area, access for firewood cutting and similar problems will be eliminated or greatly decreased.

MANAGEMENT CONCERNS

Most of the management concerns at the proposed Horse Meadow Research Natural Area result from inevitable conflicts that arise by placing a Research Natural Area in the middle of one of the most intensively used Wilderness Areas in the United States. Active research of plant communities, wildlife, or natural systems often requires some manipulation of the environment, sampling of populations through collection and trapping, measurement of physiological processes, and, in general, a scholarly attempt to find causal factors of observed phenomenon. In recent decades, throughout all natural sciences, there has been a gradual but profound shift away from purely descriptive studies that require only intensive non-intrusive visits by a researcher to a protected site.

According to the Wilderness Act of 1964, the definition of a wilderness includes the description of "...undeveloped Federal land retaining its primeval character and influence.. and which generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable." From a wilderness visitor's point of view, a flagged transect marker or even a discretely hidden scientific recorder (to measure some environmental factor over time) may be an unwelcome intrusion into the "wilderness experience." If the visitor is disgruntled enough, research markers may be removed, theft or vandalism to expensive equipment may occur, and the efforts of considerable research time may be lost.

Problems like these were a major impetus for the original establishment of Research Natural Areas and other such reserves. Unlike preserves, which are established solely to protect a community or habitat, reserves are established to ensure researchers that they can conduct studies in a wild landscape where their work will not be destroyed by encroaching

development and where they can feel confident that their work will be protected to a large degree from the frustrating effects of vandalism. Surely, this Horse Meadow site, if set aside as a Research Natural Area, must function more as a preserve than as a research reserve, which begs the question of whether it is not already adequately preserved within the Wilderness designation.

Access to the site is relatively simple and easy, as noted earlier. Access with heavy equipment may be more difficult, although pack animals are still allowed in this area. The existence of Poopout Hill Road greatly eases the task of moving equipment to the proposed RNA; however, a proposal to completely eliminate the road is under consideration by the San Bernardino National Forest (Enoki, pers.comm.). Even if Poopout Hill Road remains, managers will have to decide if researchers can have access for equipment installation and removal. Wilderness visitors generally dislike movement of vehicles along a road that is gated and locked to them, although they seem to be supportive of such use during emergency searches and similar situations.

Within the proposed RNA, slopes are quite steep. Most visitors to this Wilderness rarely hike far from trails, especially to head upslope without a particular attractive destination in mind. Thus, the approximately 17,000 visitors that walk by this proposed Research Natural Area each year may never pose a threat to research sites if the sites are properly placed at some distance from established trails. The impact of research equipment on the visitor's experience may be slight to non-existent if properly managed; similarly, if never seen, the danger of losing research results to vandalism disappears. Finally, based on personal experience conducting research in Sierran national parks, the vast majority of visitors to wilderness areas are not only not destructive, but are greatly interested in research and highly supportive of such work in our national parks and wilderness areas. The National Park Service supports researchers in a wide variety of research projects, many of which alter or measure the environment in some way. Undoubtedly, they maintain strict guidelines that establish what kinds of projects are allowable within park boundaries.

If the management concerns arising from these potentially conflicting uses can be resolved, the proposed Horse Meadow Research Natural Area has great merit as an extensive white fir site in southern California. As a species and plant community that occurs far to the north in the mountains of the Sierra Nevada, these forests are of special interest as a southerly variation of the both the red fir and white fir forests and may be a useful site for comparative studies.

BIBLIOGRAPHY

ALLEN, C.R.

- 1957 San Andreas fault zone in San Gorgonio Pass, southern California: Geol. Soc. America Bull., v. 68, p. 315-349.

AUTIER, BRENT

- 1967 A Regional Study of Mt. San Bernardino and Associated Areas. Quarterly of the San Bernardino County Museum Association, XIV, 3 & 4, p. 76-78.

CHEATHAM, N.H. and J.R. HALLER

- 1975 An Annotated list of California habitat types. in Major, J. and M.G. Barbour. Terrestrial Vegetation of California. Wiley Interscience.

COX, BRETT F., J.C. MATTI, H.W. OLIVER, and N.T. ZILKA

- 1983 Mineral Resource Potential Map of the San Gorgonio Wilderness, San Bernardino County, California. 1:62,500. USDA USGS MAP MF-1161-C.

DIBBLEE, THOMAS W., JR.

- 1964 Geologic Map of the San Gorgonio Mountain Quadrangle, San Bernardino and Riverside Counties, California. USDA USGS Miscellaneous Geol. Investigations, MAP I-431.
- 1976 San Andreas Fault in Southern California. Calif. Div. Mines and Geology, Spec. Rept. 118, pp. 127-135.

HOLLAND, ROBERT

- 1986 Preliminary Descriptions of the Terrestrial Natural Communities of California. State of California Dept. Fish and Game, Non-game Heritage Program, Sacramento, CA.

HORTON, L.E.

- 1982 Reconnaissance Report: Proposed Horse Meadow Research Natural Area, San Bernardino National Forest. unpublished US Forest Service document, #4060.

JAMES, HARRY C.

- undated One Hundred Eighty-five to The Summit. undated typescript, James papers. quoted in Robinson 1991.

MATTI, J.C., D.M. MORTON, and B.F. COX

- 1985 Distribution and geologic relations of fault systems in the vicinity of the Central Transverse Ranges, southern California. USDA USGS Geological Survey, Open File Report 85-365.

MILLER, PAUL, J.R. McBRIDE, S.L. SCHILLING and A.T. GOMEZ

- 1989 Trends of Ozone Damage to Conifer Forests between 1974-1988 in the San Bernardino Mountains of Southern California. In: R.K. Olsen and A.S. Lefohn (eds.). Effects of Air Pollution on Western Forests. A+WMA Transaction Series, ISSN 1040-8177, #16, p. 309-323. Air and Waste Management Association, Pittsburgh, PA.

MINNICK, R. A., L.S. BOWDEN and R. W. PEASE

- 1970 Mapping montane vegetation in southern California from color infrared imagery. USDA Contr. 14-08-0001-10674, Status Report III, Tech. Report III.
- 1974 The influence of fire suppression on coniferous forest of southern California: A case study of the Big Bear fire, Nov. 13-19, 1970. In: Symposium Proceedings, Living with the Chaparral. Sierra Club, San Francisco.
- 1976 Vegetation of the San Bernardino Mountains. in: Plant Communities of Southern California. June Lanning, ed. California Native Plant Society Special Publication No. 2, p. 99-124.
- 1988 The Biogeography of Fire in the San Bernardino Mountains of California. UC Publication Geography, vol. 28.
- 1991 Conifer Forest Fire Dynamics and Distribution in the Mountains of Southern California: A Landscape Steady-State Approach. Part I. Crossosoma, Vol. 17, No. 1. Southern California Botanists, Fullerton, CA.

MORTON, D.M., J.C. MATTI, and B.F. COX

- 1980 Geologic Map, San Geronimo Wilderness, California. 1:62,500. USDA USGS Geological Survey, Map MF-1161-A.

MUELLER-DOMBOIS, DIETER and HEINZ ELLENBERG

- 1974 Aims and Methods of Vegetation Ecology. John Wiley & Sons. New York. quote from pg. 81. 547 pp.

MUNZ, PHILIP A. and DAVID D. KECK

1968 A California Flora and Supplement. Univ. Calif. Press.

MUNZ, PHILIP A.

1974 A Flora of Southern California. Univ. Calif. Press.

PITKIN, JAMES A. and J.S. DUVAL

1981 Interpretation of an aerial radiometric survey of the San Gorgonio Wilderness Area and Vicinity, San Bernardino County, California. USDA USGS Miscellaneous Field Studies MAP, MF-1161-C.

RETELAS, JAMES G.

1980 Order 3 Soil Resource Inventory of San Bernardino National Forest, California. USDA Forest Service and Soil Conservation Service.

ROBINSON, JOHN W.

1978 San Gorgonio Mountain: Preserving A Wilderness. San Bernardino County Museum Association. Vol. XXV, No. 2.

1991 San Gorgonio: A Wilderness Preserved. San Gorgonio Volunteer Association. 34701 Mill Creek Road, San Bernardino, California 93459.

RUNDEL, P.W., D. J. PARSONS and D.T. GORDON

1988 Montane and Subalpine Vegetation of the Sierra Nevada and Cascade Ranges. Chapter 17 in Barbour and Major, *Terrestrial Vegetation of California*. California Native Plant Society. Special Publication Number 9.

SHARP, R.P., C. R. ALLEN, and M.R. MEIER

1959 Pleistocene glaciers on southern California mountains. Amer. Journ. Sci., v. 257, no. 2, p. 104-107.

STANKEY, GEORGE H.

1976 Rationing Wilderness Use: Visitor Evaluation of Use Control in the San Gorgonio and San Jacinto Wilderness. 222-WPU-76; Form INT 1600-12 (9/66). San Gorgonio Ranger District, San Bernardino National Forest, San Bernardino County, California. USDA-Forest Service Files, San Gorgonio Ranger District Headquarters

TAYLOR, O.C., ed.

- 1980 Photochemical oxidant air pollution effects on a mixed conifer forest ecosystem. US Environmental Protection Agency, Ecological Research Series, EPA-600/3-80-002.

THORTON, Jr., JOSEPH F.

- 1969 Recreation Management in the South Fork Meadows Basin of the San Gorgonio Wilderness. USDA Forest Service 6200-7 (4/68). US Forest Service files, Mill Creek Ranger Station, San Bernardino National Forest.

TIMOSSI, IRENE, programmer

- 1989 Statewide Wildlife Habitat Relationship Database System (version 8/8/89), California Department of Fish and Game, Resources Agency, State of California. (Originally programmed for Pacific Gas and Electric, 5/2/88)

UNITED STATES GEOLOGIC SURVEY

- 1975 Isoline map of mean annual precipitation in the California region. Published and revised by the USGS, Department of the Interior.

USDA-FOREST SERVICE

- no date San Bernadino National Forest Land and Resource Management Plan. USDA Forest Service, Pacific Southwest Region. 3 vol.
- 1970 Supplemental Multiple Use Management Guide for San Gorgonio Wilderness, Regional Code No. 399.5(j). San Gorgonio Ranger District, San Bernardino National Forest, San Bernardino County, California. USDA-Forest Service Files, San Gorgonio Ranger District Headquarters
- 1973 Wilderness Resource Plan: San Gorgonio Wilderness. San Gorgonio Ranger District, San Bernardino National Forest, San Bernardino County, California. USDA-Forest Service Files, San Gorgonio Ranger District Headquarters
- 1974 Wilderness Resource Plan: San Gorgonio Wilderness, Supplement No. 2. San Gorgonio Ranger District, San Bernardino National Forest, San Bernardino County, California. USDA-Forest Service Files, San Gorgonio Ranger District Headquarters
- 1981 Environmental Assessment: South Fork Meadows Trail Reroute Project. San Gorgonio Ranger District, San Bernardino National Forest, San Bernardino

County, California. USDA-Forest Service Files, San Gorgonio Ranger District Headquarters

- 1989 San Gorgonio Wilderness Management Plan and Environmental Assessment Report. San Gorgonio Ranger District, San Bernardino National Forest, San Bernardino County, California. USDA-Forest Service Files, San Gorgonio Ranger District Headquarters.

VASEK, FRANK AND ROBERT THORNE

- 1977 Transmontane Coniferous Vegetation. In: Terrestrial Vegetation of California, ed. Barbour and Major. Wiley Interscience. Chapter 23, p. 797-832.

VAUGHAN, F.E.

- 1922 Geology of the San Bernardino Mountains north of San Gorgonio Pass [California]. California Univ., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 319-411.

WEAVER, R.W., J.L. MENSCH, W. TIMMERMAN, and J.M. HALL

- 1972 Bighorn Sheep in the San Gabriel and San Bernardino Mountains. State of Calif. Resources Agency, Dept. Fish and Game, Wildlife Mangement Administrative Report, No. 72-2.

WOODRUFF, G.A. and W.Z. BROCK

- 1980 Soil Survey of San Bernardino County, Southwestern Part, California. USDA Soil Conservation Service with Univ.Calif. Ag. Experiment Station.

ZEINER, D.C., W.F. LAUDERSLAYER, K.E. MAYER, and M. WHITE, eds.

- 1988 California's Wildlife: Volumes 1-3. State of California Resources Agency, Department of Fish and Game.

APPENDIX A: THE PLANTS OF HORSE MEADOW
Candidate Research Natural Area
Mary Theresa Burke and Andy Sanders, 1991

FERNS AND ALLIES

SELAGINELLACEAE

Selaginella watsonii Underwood

EQUISETACEAE

Equisetum laevigatum A. Br.

ASPIDIACEAE

Woodsia sp.

PTERIDACEAE

Pteridium aquilinum (L.) Kuhn var. *pubescens* Underw.

CONIFEROUS PLANTS

CUPRESSACEAE

Juniperus occidentalis Hook. var. *australis* Vasek

PINACEAE

Abies concolor (Gord. & Glend.) Lindl.

Pinus flexilis James.

Pinus jeffreyi Grev. & Balf. in A.Murr.

Pinus contorta Loudon ssp. *murrayana* (Grev. & Balf.) Critchfield

DICOTYLEDONS

APIACEAE

Sphenosciadium capitellatum Gray

APOCYNACEAE

Apocynum androsaemifolium L.

ASTERACEAE

Achillea sp.

Achillea millefolium L.

Artemisia dracunculus L.

Artemisia ludoviciana Nutt.

Artemisia tridentata Nutt. ssp. *tridentata*

Chrysothamnus nauseosus (Pall.) Britten

Chrysothamnus parryi (Gray) Greene

Chrysothamnus viscidiflorus (Hook.) Nutt.



Cirsium condgonii Moore & Franklin [syn. *C. drummondii*]
Erigeron breweri Gray
Hieracium albiflorum Hook
Solidago californica Nutt.
Solidago canadensis L.
Taraxacum californicum M & J.
Taraxacum laevigatum (Willd.)DC.
Taraxacum officinalis Wiggers.
Tetradymia canescens DC.

BRASSICACEAE

Arabis sp.
Barbarea orthoceras Ledeb.
Cardamine sp.
Draba corrugata Wats.
Erysimum capitatum (Dougl.)Greene

BORAGINACEAE

Cryptantha echinella Greene

CAPRIFOLIACEAE

Symphoricarpus parishii Rydb.

CARYOPHYLLACEAE

Silene cf. *aperta*
Silene verecunda Wats.

CRASSULACEAE

Sedum spathulifolium Hook. ssp. *anomalum* (Britt)Clausen & Uhl.

ERICACEAE

Arctostaphylos patula Greene ssp. *platyphylla*
Phyllodoce breweri (Gray)Heller

EUPHORBIACEAE

Euphorbia palmeri Engelm.

FABACEAE

Amorpha californica Nutt.
Lotus nevadensis Greene
Lotus oblongifolius (Benth.)Greene
Lupinus formosus Greene
Lupinus polyphyllus Lindl.
Trifolium sp.

FAGACEAE

Chrysolepis sempervirens (Kell)Hjelmquist.
Quercus kelloggii Newb.

GERANIACEAE

Geranium richardsonii Fisch. & Trautv.

HYPERICACEAE

Hypericum anagalloides Cham. & Schlecht.

LAMIACEAE

Monardella linoides Gray ssp. *stricta* (Parish) Epling

Stachys albens Gray

ONAGRACEAE

Gayophytum diffusum T.+G. ssp. *parviflorum* Lewis & Szweykowski

PYROLACEAE

Pyrola picta Sm.

RANUNCULACEAE

Aquilegia formosa Fisch. in DC. var. *pauciflora* (Greene) Boothman

Delphinium parishii Gray ssp. *parishii*

RHAMNACEAE

Ceanothus cordulatus Kell.

ROSACEAE

Amelanchier sp.

Horkelia wilderae Parish.

Potentilla glandulosa Lindl.

Potentilla wheeleri Wats.

Rosa californica C. & S.

Rosa woodsii Lindl.

Rubus sp.

RUBIACEAE

Galium cf. *nuttallii* Gray

Kellogia galioides Torr.

SALICACEAE

Salix lasiolepis Benth.

Salix scouleriana Barr.

SAXIFRAGACEAE

Heuchera sp.

Ribes cereum Dougl.

Ribes montigenum McClat.(L.) Kuhn var. *pubescens* Underw.

Ribes nevadense Kell.

Ribes roezlii Regel.



SCROPHULARIACEAE

Castilleja sp.
Castilleja martinii Abrams var. *martinii*
Castilleja miniata Dougl. ex. Hook.
Castilleja montigena Heckard
Mimulus breweri (Greene)Cov.
Mimulus guttatus Fisch. ssp. *guttatus*
Pedicularis semibarbata Gray
Penstemon bridgesii Gray
Penstemon caesius Gray
Penstemon grinnellii Eastw. ssp. *grinnellii* (Jones)Munz
Penstemon labrosus (Gray)Hook.
Verbascum thapsus L.
Veronica americana (Raf.)Schw.

SOLANACEAE

Nicotiana attenunata Torr.
Solanum xantii Gray var. *montanum* Munz

VIOLACEAE

Viola cf. *purpurea* Kell. not Stev.

MONOCOTYLEDONS

CYPERACEAE

Carex cf. *senta* Boott.
Carex sp.
Carex heteroneura Boott.
Carex hoodii Boott.

IRIDACEAE

Sisyrinchium idahoense Bickn.

JUNCACEAE

Juncus sp.
Juncus mertensiana Bong.

LILIACEAE

Calochortus invenustus Greene
Lilium parryi Wats.

ORCHIDACEAE

Corralorhiza maculata Raf.
Epipactis gigantea Dougl. ex Hook.

POACEAE

Agropyron sp.
Agropyron trachycaulum (Link)Malte
Bromus sp.

Bromus ciliatus L.
Bromus tectorum L.
Elymus sp.
Muhlenbergia richardsonis (Trin.) Rydb.
Poa fendleriana (Steud.) Vasey
Poa palustris L.
Poa pratensis L.
Sitanion hystrix (Nutt.) J.G. Sm.

APPENDIX B: CHECKLIST OF PLANTS OF HORSE MEADOW

Candidate Research Natural Area

Mary Burke and Andy Sanders

1991

All page numbers refer to Munz' "A Flora of Southern California", except where preceded by an "M...". These numbers refer to Munz and Keck's "A California Flora".

Family	PgNo	Plant Name	Plant Notes
PIN	38	<i>Abies concolor</i>	erect solitary needles
AST	106	<i>Achillea</i> sp.	
AST	106	<i>Achillea millefolium</i>	Flattish cyme of small heads.
POA	940	<i>Agropyron</i> sp.	like <i>Elymus</i> , but 1 spikelet/node
POA	940	<i>Agropyron trachycaulum</i>	
ROS	742	<i>Amelanchier</i> sp.	Large shrub, deciduous, uncommon
FAB	422	<i>Amorpha californica</i>	
APO	88	<i>Apocynum androsaemifolium</i>	Perennial to 1 ft, opposite lvs, campanulate flws.
RAN	721	<i>Aquilegia formosa</i> var. <i>pauciflora</i>	
BRA	270	<i>Arabis</i> sp.	Grayish perennial herb.
ERI	400	<i>Arctostaphylos patula</i> ssp. <i>platyphylla</i>	Broad ovate lvs, truncate base. Common shrub, bright green lvs.
AST	117	<i>Artemisia dracunculus</i>	Common perennial herb to 2 ft.
AST	117	<i>Artemisia ludoviciana</i>	Peren. herb, whitish lobed lvs., along Deep Creek
AST	119	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>	Uncommon shrub. Sessile lvs w/3 blunt teeth.
BRA	276	<i>Barbarea orthoceras</i>	Broad lobed lvs, prostrate in rosettes, wet soil.
POA	951	<i>Bromus</i> sp.	
POA	952	<i>Bromus ciliatus</i>	canescent leaves
POA	956	<i>Bromus tectorum</i>	drooping reddish inflor.
LIL	924	<i>Calochortus invenustus</i>	white to lilac with green stripe
BRA	279	<i>Cardamine</i> sp.	Small herb in meadows.
CYP	885	<i>Carex</i> cf. <i>senta</i>	black carex
CYP	885	<i>Carex</i> sp.	
CYP	885	<i>Carex heteroneura</i>	
CYP	885	<i>Carex hoodii</i>	
SCR	793	<i>Castilleja</i> sp.	
SCR	796	<i>Castilleja martinii</i> var. <i>martinii</i>	
SCR	797	<i>Castilleja miniata</i>	
SCR	797	<i>Castilleja montigena</i>	[<i>C. martinii ewanii</i>] CNPS List 4. herb, wavy leaf margins
RHA	733	<i>Ceanothus cordulatus</i>	common low shrub, spiny, grayish lvs.
FAG	478	<i>Chrysolepis sempervirens</i>	
AST	142	<i>Chrysothamnus nauseosus</i>	Infl. strongly clustered at top, twigs tomentose, linear lvs.
AST	144	<i>Chrysothamnus parryi</i>	Infl. loose, lvs linear with little clusters at base, no rays.
AST	145	<i>Chrysothamnus viscidiflorus</i>	1-2 ft. shrub, green twisted (spiral) lvs.
AST	147	<i>Cirsium condgonii</i>	[syn. <i>C. drummondii</i>] Stemless thistle, meadows.
ORC	932	<i>Corralorhiza maculata</i>	
BOR	251	<i>Cryptantha echinella</i>	
RAN	724	<i>Delphinium parishii</i> ssp. <i>parishii</i>	
BRA	288	<i>Draba corrugata</i>	small hairy rosette
POA	965	<i>Elymus</i> sp.	perennial, 2-3 spikelets/node

ORC	933	<i>Epipactis gigantea</i>	wet places, ca. 1 ft. high, broad based lvs.
EQU	16	<i>Equisetum laevigatum</i>	single black whorl
AST	160	<i>Erigeron breweri</i>	
BRA	290	<i>Erysimum capitatum</i>	Spreading siliques.
EUP	413	<i>Euphorbia palmeri</i>	Flat lvs, milky juice.
RUB	768	<i>Galium cf. nuttallii</i>	
ONA	610	<i>Gayophytum diffusum</i> ssp. <i>parviflorum</i>	
GER	492	<i>Geranium richardsonii</i>	whitish flw, purple veins; purple glands on pedicel
SAX	779	<i>Heuchera</i> sp.	
AST	188	<i>Hieracium albiflorum</i>	Perennial, hairy lvs.
BOR	749	<i>Horkelia wilderae</i>	low herb, dry slopes
HYP	519	<i>Hypericum anagalloides</i>	Herb, prostrate dwarf, wet banks.
JUN	909	<i>Juncus</i> sp.	AS reports 3 sp. present, wet places, perennial
JUN	912	<i>Juncus mertensiana</i>	
CUP	37	<i>Juniperus occidentalis</i> var. <i>australis</i>	
RUB	770	<i>Kelloggia galioides</i>	Pink flw, small, glabrous, opp. lvs
LIL	928	<i>Lilium parryi</i>	
FAB	447	<i>Lotus nevadensis</i>	Dry slopes, prostrate.
FAB	449	<i>Lotus oblongifolius</i>	Wet places.
FAB	457	<i>Lupinus formosus</i>	Narrow lvs.
FAB	461	<i>Lupinus polyphyllus</i>	Broad palmate comp. lvs.
SCR	810	<i>Mimulus breweri</i>	glandular-pubs., smaller, yellow
SCR	812	<i>Mimulus guttatus</i> ssp. <i>guttatus</i>	large, yellow, glabrous
LAM	530	<i>Monardella linoides</i> ssp. <i>stricta</i>	Uncommon subshrub in rocky areas.
POA	984	<i>Muhlenbergia richardsonis</i>	Stems silvery, lvs green.
SOL	835	<i>Nicotiana attenunata</i>	dense tufts to 1 ft. high
SCR	818	<i>Pedicularis semibarbata</i>	
SCR	820	<i>Penstemon bridgesii</i>	brilliant red flw, upper lip extended, lower reflexed
SCR	820	<i>Penstemon caesius</i>	mid-blue flw, gray lvs
SCR	822	<i>Penstemon grinnellii</i> ssp. <i>grinnellii</i>	inflated sky blue flws
SCR	822	<i>Penstemon labrosus</i>	clusters of strapshaped green lvs.
ERI	402	<i>Phyllodoce breweri</i>	
PIN	40	<i>Pinus contorta</i> ssp. <i>murrayana</i>	two short needles/bundle
PIN	39	<i>Pinus flexilis</i>	5 needles/fascicle
PIN	39	<i>Pinus jeffreyi</i>	vanilla scented bark
POA	994	<i>Poa fendleriana</i>	very common clump-forming perennial, ca 10" high
POA	994	<i>Poa palustris</i>	
POA	995	<i>Poa pratensis</i>	rhizomatous perennial in meadows
ROS	753	<i>Potentilla glandulosa</i>	tall w/creamy flowers, pinnate compound lvs., moist areas
ROS	755	<i>Potentilla wheeleri</i>	palmate and low, a bit silvery, mwds
PTE	32	<i>Pteridium aquilinum</i> var. <i>pubescens</i>	common, about 2 ft. high
PYR	403	<i>Pyrola picta</i>	
FAG	481	<i>Quercus kelloggii</i>	Lobed lvs.
SAX	785	<i>Ribes cereum</i>	no spines, long tube, lobed lvs
SAX	788	<i>Ribes montigenum</i> var. <i>pubescens</i>	
SAX	788	<i>Ribes nevadense</i>	no spines, wet places, highly deciduous lg. lvs.
SAX	788	<i>Ribes roezlii</i>	
ROS	759	<i>Rosa californica</i>	flattened curved spines
ROS	759	<i>Rosa woodsii</i>	spines straight, slender, not curved
ROS	759	<i>Rubus</i> sp.	bicolor raspberry
SAL	775	<i>Salix lasiolepis</i>	
SAL	776	<i>Salix scouleriana</i>	

CRA	389	<i>Sedum spathulifolium</i> ssp. <i>anomalum</i>	
SEL	15	<i>Selaginella watsonii</i>	
CAR	M289	<i>Silene</i> cf. <i>aperta</i>	long calyx lobes
CAR	344	<i>Silene verecunda</i>	
IRI	908	<i>Sisyrinchium idahoense</i>	
POA	999	<i>Sitanion hystrix</i>	Common clump-forming perennial, bristly inflor.
SOL	840	<i>Solanum xantii</i> var. <i>montanum</i>	
AST	228	<i>Solidago californica</i>	Perennial herb, broad lvs.
AST	M1185	<i>Solidago canadensis</i>	Perennial, slender lvs.
API	86	<i>Sphenosciadium capitellatum</i>	Perennial in meadows, 2-3 ft. high.
LAM	541	<i>Stachys albens</i>	dense cobwebby hairs
CAP	334	<i>Symphoricarpus parishii</i>	san bern. montane sp.
AST	234	<i>Taraxacum californicum</i>	Lvs not much lobed, meadows.
AST	234	<i>Taraxacum laevigatum</i>	Like common dandelion, meadows.
AST	234	<i>Taraxacum officinalis</i>	lyrate lvs, calyx recurved, bright yellow.
			Rare T. calif: entire; upright; pale yellow
AST	235	<i>Tetradymia canescens</i>	White tomentose composite.
FAB	470	<i>Trifolium</i> sp.	3 leaflets.
SCR	827	<i>Verbascum thapsus</i>	very large wooly lvs
SCR	828	<i>Veronica americana</i>	blue flw, soft entire lvs
VIO	854	<i>Viola</i> cf. <i>purpurea</i>	perennial herb
ASP	22	<i>Woodsia</i> sp.	small (to 6 in.) in shade

APPENDIX C: PREDICTED WILDLIFE OF HORSE MEADOWS CANDIDATE RNA
 California Department of Fish and Game Wildlife Habitat Relationship System (Timossi, 1989)

Steve Loe, Forest Wildlife Biologist, USFS San Bernardino National Forest

Status Definitions:

FE: Federally Endangered
 FT: Federally Threatened
 CE: California Endangered
 CT: California Threatened
 CP: California Protected
 FS: Forest Service Sensitive
 BS: BLM Sensitive
 H : Harvest Species
 CalSC: California Species of Special Concern

ID#	Common Name	Scientific Name	Family	Status
AMPHIBIANS				
A012	Ensatina	Ensatina eschscholtzi	Plethodontidae	
A044	Mountain Yellow-Legged Frog	Rana muscosa	Ranidae	
BIRDS				
B108	Turkey Vulture	Cathartes aura	Cathartida	
B115	Sharp-Shinned Hawk	Accipiter striatus	Accipitridae	CalSC
B116	Cooper's Hawk	Accipiter cooperii	Accipitridae	CalSC
B117	Northern Goshawk	Accipiter gentilis	Accipitridae	FS; CalSC
B123	Red-Tailed Hawk	Buteo jamaicensis	Accipitridae	
B126	Golden Eagle	Aquila chrysaetos	Accipitridae	CP; FS; CalSC
B127	American Kestrel	Falco sparverius	Falconidae	
B128	Merlin	Falco columbarius	Falconidae	CalSC
B131	Prairie Falcon	Falco mexicanus	Falconidae	FS
B141	Mountain Quail	Oreortyx pictus	Phasianidae	H
B251	Band-Tailed Pigeon	Columba fasciata	Columbiidae	H
B255	Mourning Dove	Zenaidura macroura	Columbidae	H
B262	Common Barn Owl	Tyto alba	Tytonidae	
B263	Flammulated Owl	Otus flammeolus	Strigidae	
B264	Western Screech Owl	Otus kennicottii	Strigidae	
B265	Great Horned Owl	Bubo virginianus	Strigidae	
B267	Northern Pygmy Owl	Glaucidium gnoma	Strigidae	
B270	Spotted Owl	Strix occidentalis	Strigidae	FS; CalSC
B272	Long-Eared Owl	Asio otus	Strigidae	CalSC
B274	Northern Saw-Whet Owl	Aegolius acadicus	Strigidae	
B276	Common Nighthawk	Cordeiles minor	Caprimulgidae	
B277	Common Poorwill	Phalaenoptilus nuttallii	Caprimulgidae	
B278	Whip-Poor-Will	Caprimulgus vociferus	Caprimulgidae	
B289	Calliope Hummingbird	Stellula calliope	Trochilidae	
B294	Lewis' Woodpecker	Melanerpes lewis	Picidae	
B298	Red-Naped Sapsucker	Sphyrapicus nuchalis	Picidae	
B299	Red-Breasted Sapsucker	Sphyrapicus ruber	Picidae	
B300	Williamson's Sapsucker	Sphyrapicus thyroideus	Picidae	
B304	Hairy Woodpecker	Picoides villosus	Picidae	
B305	White-headed Woodpecker	Picoides albicollis	Picidae	
B307	Northern Flicker	Colaptes auratus	Picidae	
B309	Olive-sided Flycatcher	Contopus borealis	Tyrannidae	
B311	Western Wood-Pewee	Contopus sordidulus	Tyrannidae	
B318	Dusky Flycatcher	Empidonax oberholseri	Tyrannidae	
B340	Violet-Green Swallow	Tachycineta thalassina	Hirundinidae	
B346	Steller's Jay	Cyanocitta stelleri	Corvidae	
B350	Clark's Nutcracker	Nucifraga columbiana	Corvidae	
B353	American Crow	Corvus brachyrhynchos	Corvidae	H
B354	Common Raven	Corvus corax	Corvidae	
B356	Mountain Chickadee	Parus gambeli	Paridae	
B361	Red-Breasted Nuthatch	Sitta canadensis	Sittidae	
B362	White-Breasted Nuthatch	Sitta carolinensis	Sittidae	
B363	Pygmy Nuthatch	Sitta pygmaea	Sittidae	
B364	Brown Creeper	Certhia americana	Certhiidae	

B368	Bewick's Wren	<i>Thryomanes bewickii</i>	Troglodytidae	
B375	Golden-Crowned Kinglet	<i>Regulus satrapa</i>	Muscicapidae	
B376	Ruby-Crowned Kinglet	<i>Regulus calendula</i>	Muscicapidae	
B380	Western Bluebird	<i>Sialia mexicana</i>	Muscicapidae	
B381	Mountain Bluebird	<i>Sialia currucoides</i>	Muscicapidae	
B382	Townsend's Solitaire	<i>Myadestes townsendi</i>	Muscicapidae	
B386	Hermit Thrush	<i>Catharus guttatus</i>	Muscicapidae	
B389	American Robin	<i>Turdus migratorius</i>	Muscicapidae	
B391	Wrentit	<i>Chamaea fasciata</i>	Muscicapidae	
B411	European Starling	<i>Sturnus vulgaris</i>	Sturnidae	
B418	Warbling Vireo	<i>Vireo gilvus</i>	Vireonidae	
B425	Orange-Crowned Warbler	<i>Vermivora celata</i>	Emberizidae	
B426	Nashville Warbler	<i>Vermivora ruficapilla</i>	Emberizidae	
B430	Yellow Warbler	<i>Dendroica petechia</i>	Emberizidae	CalSC
B435	Yellow-Rumped Warbler	<i>Dendroica coronata</i>	Emberizidae	
B436	Black-Throated Gray Warbler	<i>Dendroica nigrescens</i>	Emberizidae	
B437	Townsend's Warbler	<i>Dendroica townsendi</i>	Emberizidae	
B438	Hermit Warbler	<i>Dendroica occidentalis</i>	Emberizidae	
B463	Wilson's Warbler	<i>Wilsonia pusilla</i>	Emberizidae	
B471	Western Tanager	<i>Piranga ludoviciana</i>	Emberizidae	
B477	Lazuli Bunting	<i>Passerina amoena</i>	Emberizidae	
B504	Fox Sparrow	<i>Passerella iliaca</i>	Emberizidae	CalSC
B506	Lincoln's Sparrow	<i>Melospiza lincolnii</i>	Emberizidae	
B510	White-Crowned Sparrow	<i>Zonotrichia leucophrys</i>	Emberizidae	
B512	Dark-Eyed Junco	<i>Junco hyemalis</i>	Emberizidae	
B521	Western Meadowlark	<i>Sturnella neglecta</i>	Emberizidae	
B528	Brown-Headed Cowbird	<i>Molothrus ater</i>	Emberizidae	
B536	Purple Finch	<i>Carpodacus purpureus</i>	Fringillidae	
B537	Cassin's Finch	<i>Carpodacus cassinii</i>	Fringillidae	
B539	Red Crossbill	<i>Loxia curvirostra</i>	Fringillidae	
B542	Pine Siskin	<i>Carduelis pinus</i>	Fringillidae	
B543	Lesser Goldfinch	<i>Carduelis psaltria</i>	Fringillidae	
B546	Evening Grosbeak	<i>Coccothraustes vespertinus</i>	Fringillidae	CalSC

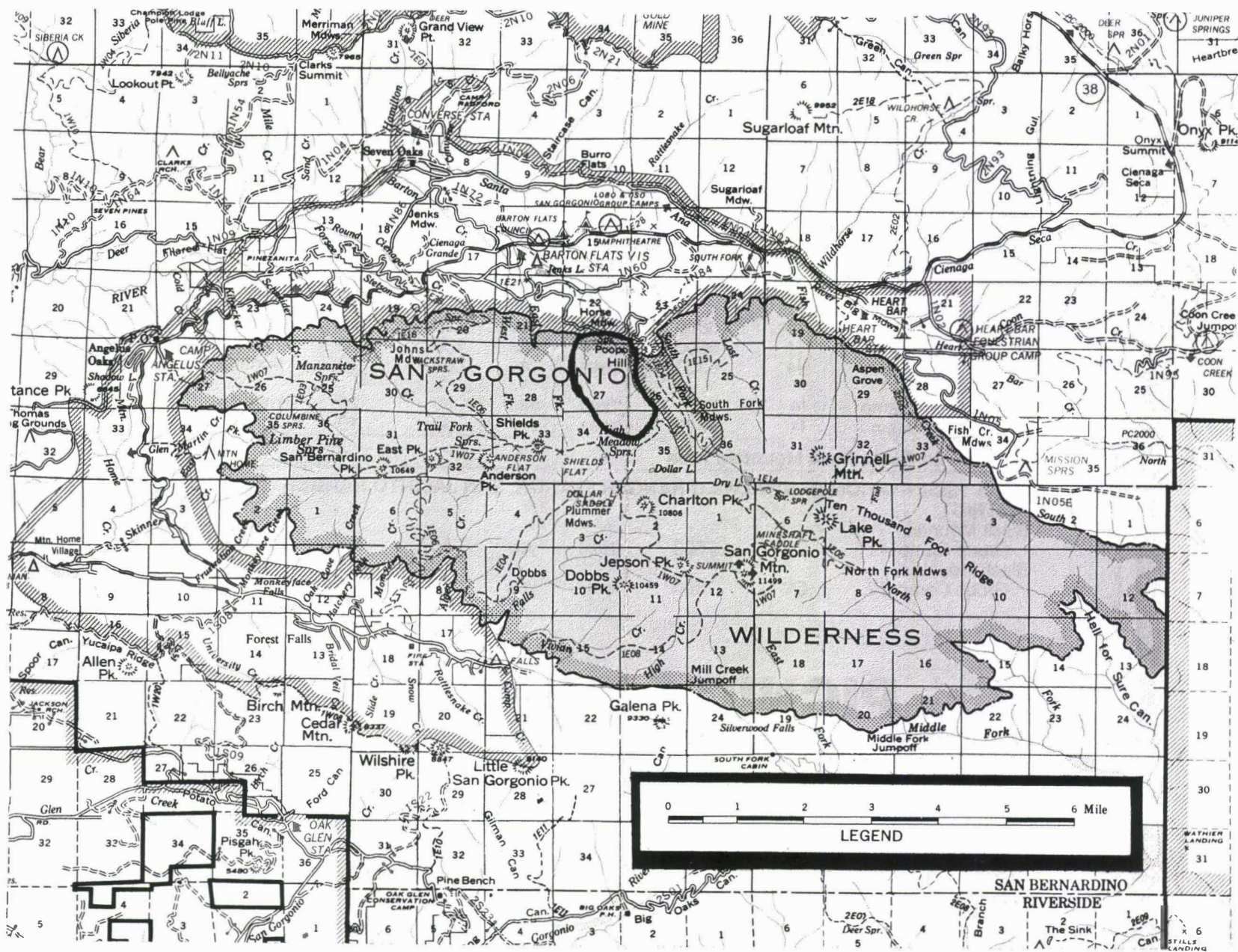
MAMMALS

M004	Dusky Shrew	<i>Sorex monticolus</i>	Soricidae	
M018	Broad-footed Mole	<i>Scapanus latimanus</i>	Talpidae	
M021	Little Brown Myotis	<i>Myotis lucifugus</i>	Vespertilionidae	
M023	Yuma Myotis	<i>Myotis yumanensis</i>	Vespertilionidae	
M025	Long-Eared Myotis	<i>Myotis evotis</i>	Vespertilionidae	
M026	Fringed Myotis	<i>Myotis thysanodes</i>	Vespertilionidae	
M027	Long-Legged Myotis	<i>Myotis volans</i>	Vespertilionidae	
M028	California Myotis	<i>Myotis californica</i>	Vespertilionidae	
M029	Small-Footed Myotis	<i>Myotis leibii</i>	Vespertilionidae	
M031	Western Pipistrelle	<i>Pipistrellus hesperus</i>	Vespertilionidae	
M032	Big Brown Bat	<i>Eptesicus fuscus</i>	Vespertilionidae	
M033	Red Bat	<i>Lasiurus borealis</i>	Vespertilionidae	
M034	Hoary Bat	<i>Lasiurus cinereus</i>	Vespertilionidae	
M036	Spotted Bat	<i>Euderma maculatum</i>	Vespertilionidae	CalSC
M037	Townsend's Big-Eared Bat	<i>Plecotus townsendii</i>	Vespertilionidae	CalSC
M038	Pallid Bat	<i>Antrozous pallidus</i>	Vespertilionidae	CalSC
M039	Brazilian Free-Tailed Bat	<i>Tadarida brasiliensis</i>	Molossidae	
M060	Merriam's Chickmunk	<i>Eutamias merriami</i>	Sciuridae	
M061	California Chipmunk	<i>Eutamias obscurus</i>	Sciuridae	
M063	Lodgepole Chipmunk	<i>Eutamias speciosus</i>	Sciuridae	
M072	California Ground Squirrel	<i>Spermophilus beecheyi</i>	Sciuridae	
M075	Golden-Mantled Ground Squirrel	<i>Spermophilus lateralis</i>	Sciuridae	
M077	Western Gray Squirrel	<i>Sciurus griseus</i>	Sciuridae	H
M080	Northern Flying Squirrel	<i>Glaucomys sabrinus</i>	Sciuridae	CalSC
M081	Botta's Pocket Gopher	<i>Thomomys bottae</i>	Geomyidae	
M113	Western Harvest Mouse	<i>Reithrodontomys megalotis</i>	Cricetidae	CalSC
M116	California Mouse	<i>Peromyscus californicus</i>	Cricetidae	
M117	Deer Mouse	<i>Peromyscus maniculatus</i>	Cricetidae	CalSC
M119	Brush Mouse	<i>Peromyscus boylii</i>	Cricetidae	
M120	Pinyon Mouse	<i>Peromyscus truei</i>	Cricetidae	
M127	Dusky-Footed Woodrat	<i>Neotoma fuscipes</i>	Cricetidae	CalSC
M134	California Vole	<i>Microtus californicus</i>	Cricetidae	CalSC
M136	Long-Tailed Vole	<i>Microtus longicaudus</i>	Cricetidae	

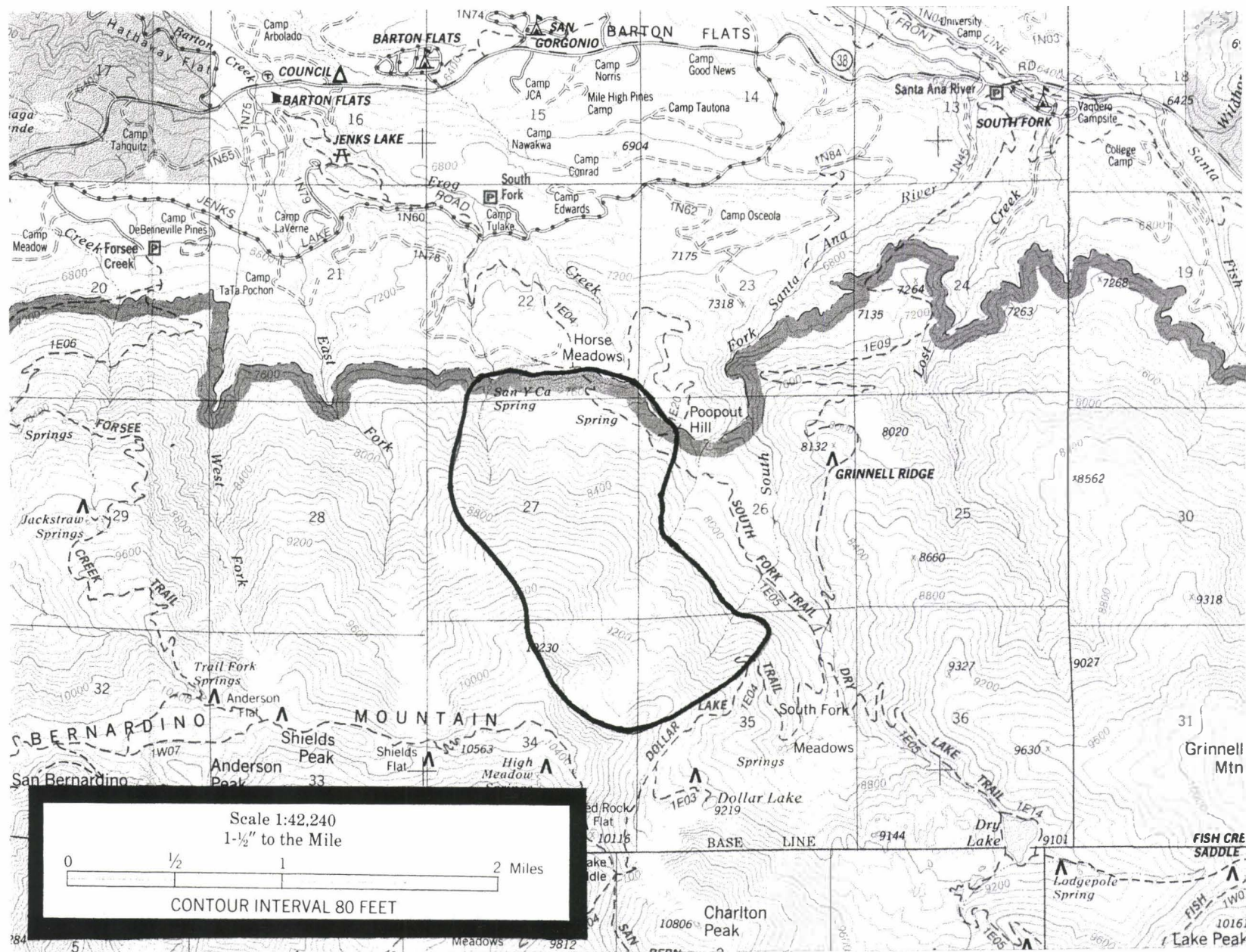
M145	Porcupine	Erethizon dorsatum	Erethizontidae	
M146	Coyote	Canis latrans	Canidae	H
M149	Gray Fox	Urocyon cinereoargenteus	Canidae	H
M151	Black Bear	Ursus americanus	Ursidae	H
M153	Raccoon	Procyon lotor	Procyonidae	H
M157	Long-Tailed Weasel	Mustela frenata	Mustelidae	H
M162	Striped Skunk	Mephitis mephitis	Mustelidae	H
M165	Mountain Lion	Felis concolor	Felidae	H; CalSC
M181	Mule Deer	Odocoileus hemionus	Cervidae	H

REPTILES

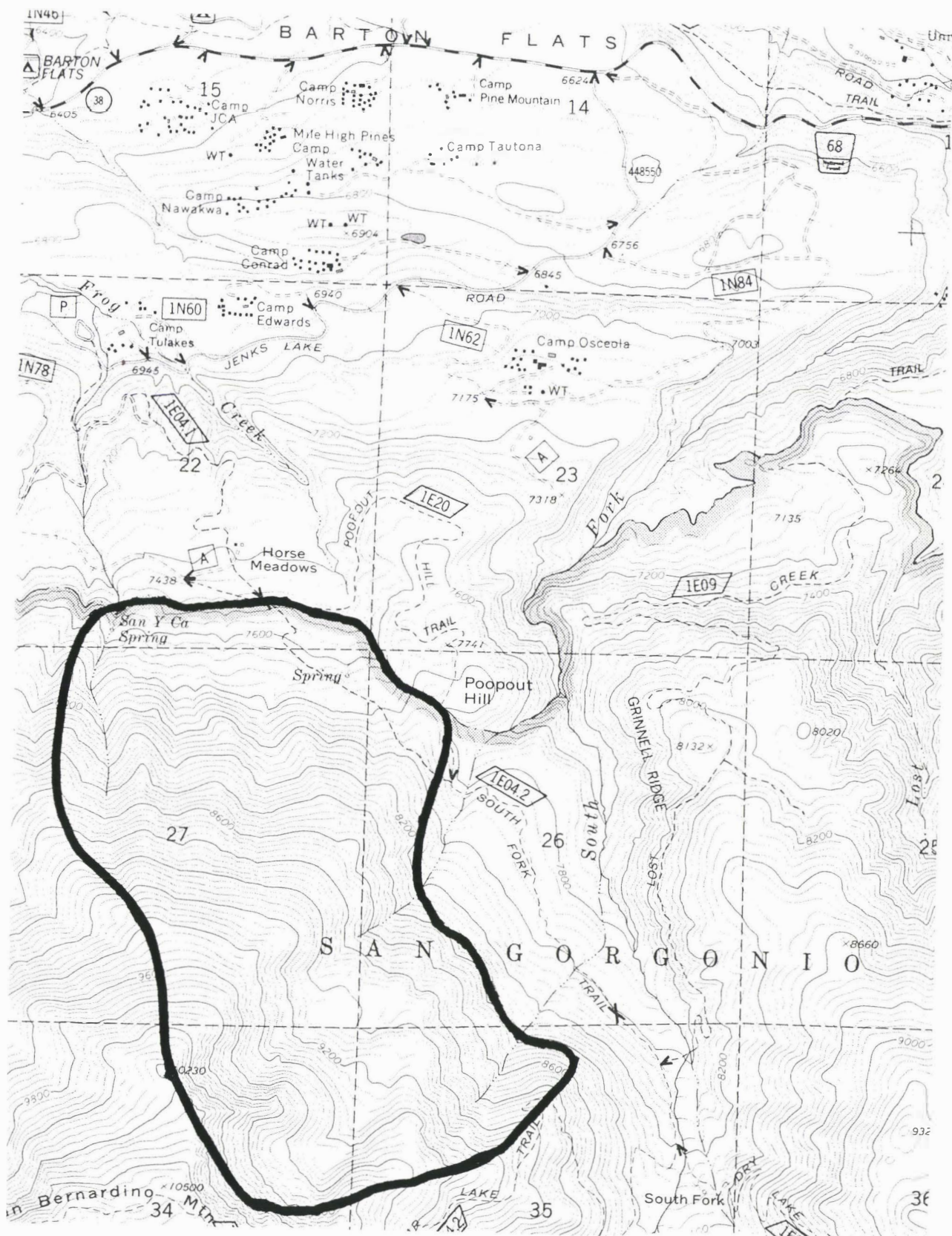
R022	Western Fence Lizard	Sceloporus occidentalis	Iguanidae	
R023	Sagebrush Lizard	Sceloporus graciosus	Iguanidae	
R046	Rubber Boa	Charina bottae	Boidae	
R059	California Mountain Kingsnake	Lampropeltis zonata	Colubridae	
R061	Common Garter Snake	Thamnophis sirtalis	Colubridae	
R062	Western Terrestrial Garter Snake	Thamnophis elegans	Colubridae	
R063	Western Aquatic Garter Snake	Thamnophis couchi	Colubridae	
R076	Western Rattlesnake	Crotalus viridis	Viperidae	



MAP 2. US FOREST SERVICE VICINITY MAP.
 San Bernardino National Forest Map. San Bernardino Mountain Area. San Bernardino Meridian. 1981.



MAP 3. US FOREST SERVICE SAN GORGONIO WILDERNESS MAP.
A Guide to the San Gorgonio Wilderness. San Bernardino National Forest. 1989.



MAP 4. MOONRIDGE, CALIF. (1:24,000).
Horse Meadow Ridge Candidate Research Natural Area.
San Gorgonio Ranger District. San Bernardino National Forest.

KEY FOR GENERAL VEGETATION MAP OF THE SAN BERNARDINO MOUNTAINS.
Taken in full from Minnick (1976).

I	A	CALIFORNIA SAGE SCRUB (Ac, Ef, Sa, Sm)	SF	<u>Pinus lambertiana</u> , <u>Abies concolor</u> domi-
II	C	CHAPARRAL		nant over <u>P. jeffreyi</u> , <u>P. ponderosa</u>
	Caf	Chamise Chaparral (Af dominant over other chaparral shrubs)	SFB	with <u>Quercus kelloggii</u>
	Ch	Mixed Chaparral (Ag, Agl, Ccr, Cd, Cb, Qd, Qw, together dominant over Af)	SFct	with Timberland Chaparral
	Co	Oak Chaparral (Qd, Qw dominant over other chaparral shrubs)	SFcl	with <u>Cercocarpus ledifolius</u>
	Cd	Desert Chaparral (Cg, Cb, Fc, Ag, Qw together dominant over Qt)	VII Ct	TIMBERLAND CHAPARRAL (Ap, Cco, Cs)
III		OAK WOODLAND	VIII	LODGEPOLE PINE FOREST
	Wa	<u>Quercus agrifolia</u>	L	<u>Pinus murrayana</u> , <u>P. flexilis</u>
	W	<u>Quercus chrysolepis</u>	Lct	with Timberland Chaparral
IV		CONIFER FORESTS IN CHAPARRAL	Lcl	with <u>Cercocarpus ledifolius</u>
	KCh	<u>Pinus attenuata</u> in Mixed Chaparral	IX	PINYON WOODLAND
	CCh	<u>Pinus coulteri</u> in Mixed Chaparral	P	<u>Pinus monophylla</u>
	BsW	<u>Pseudotsuga macrocarpa</u> , <u>Quercus chrysolepis</u>	PJoCl,	with <u>Juniperus occidentalis</u> , <u>Cerco-</u>
V		MARGINAL FORESTS	or PJo	<u>carpus ledifolius</u>
	CW	<u>Pinus coulteri</u> , <u>Quercus chrysolepis</u>	Cl	<u>Cercocarpus ledifolius</u>
	CB	<u>Pinus coulteri</u> , <u>Quercus kelloggii</u>	PW	with <u>Quercus chrysolepis</u>
	B	<u>Quercus kelloggii</u>	PGb	with Great Basin Sage Scrub
VI		WESTERN CONIFEROUS FOREST	PCd	with Desert Chaparral
	JY	<u>Pinus jeffreyi</u> , <u>P. ponderosa</u> dominant over <u>P. lambertiana</u> , <u>Abies concolor</u>	PQt	with Desert Oak Scrub
	JYW	with <u>Quercus chrysolepis</u>	X Gb	GREAT BASIN SAGE SCRUB (Atr, Chn, Pg)
	JYB	with <u>Quercus kelloggii</u>	XI Qt	DESERT OAK SCRUB (Qt dominant over Cg, Cb, Fc, Qw)
	JYct	with Timberland Chaparral	XII	JUNIPER WOODLAND (<u>Juniperus californica</u>)
	JYcl-Jo	with <u>Cercocarpus ledifolius</u> ,	JcQt	with Desert Oak Scrub
or	JYcl	<u>Juniperus occidentalis</u>	JcYb	with <u>Yucca brevifolia</u>
	JYGb	with Great Basin Sage Scrub	Jcd	with Desert Vegetation
			XIII	JOSHUA TREE WOODLAND (<u>Yucca brevifolia</u>)
			YbGb	with Great Basin Sage Scrub
			YbD	with Desert Vegetation
			XIV D	DESERT VEGETATION
			XV Ba	BARREN

KEY TO MAP 7 AND MAP 8

GEOLOGIC MAP LEGEND: HORSE MEADOW (Abstracted from Dibblee, 1964)

PRECAMBRIAN METAMORPHIC ROCKS

gn: Gneissic Rocks. Quartz diorite to quartz monzonite gneiss. Light to dark-gray, fine- to coarse-grained, ranges from laminated gneiss to gneissoid quartz diorite, composed of plagioclase, quartz, biotite, potassic feldspar, and hornblende in general order of decreasing abundance, with small amounts of muscovite, sphene, apatite, and clinozoisite.

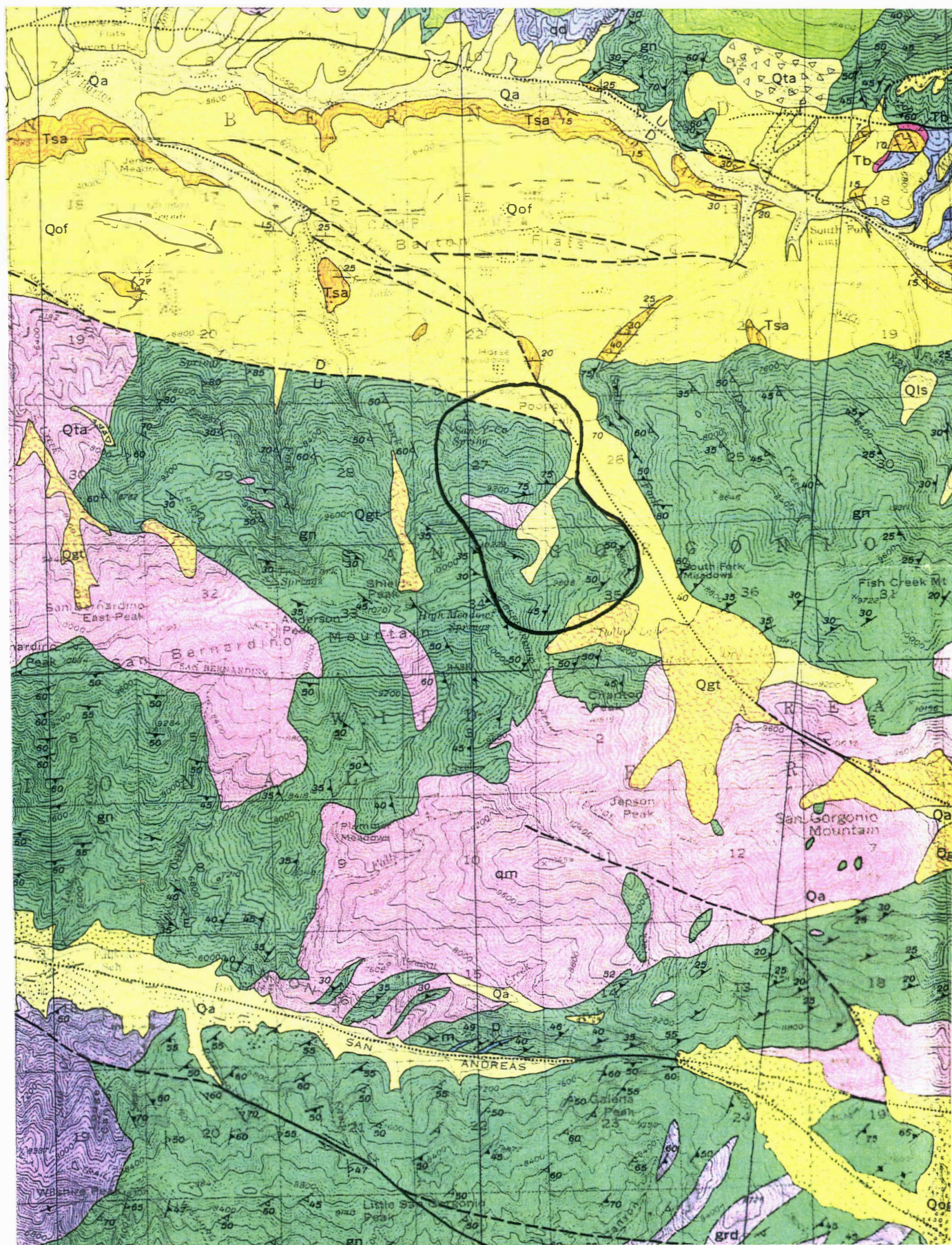
MESOZOIC PLUTONIC ROCKS

qm: Quartz Monzonite. Gray-white, generally massive, medium-grained granitic rock composed of quartz, potassic feldspar, and plagioclase (oligoclase) in generally equal proportions. Weathered rock buff-white, weakly coherent.

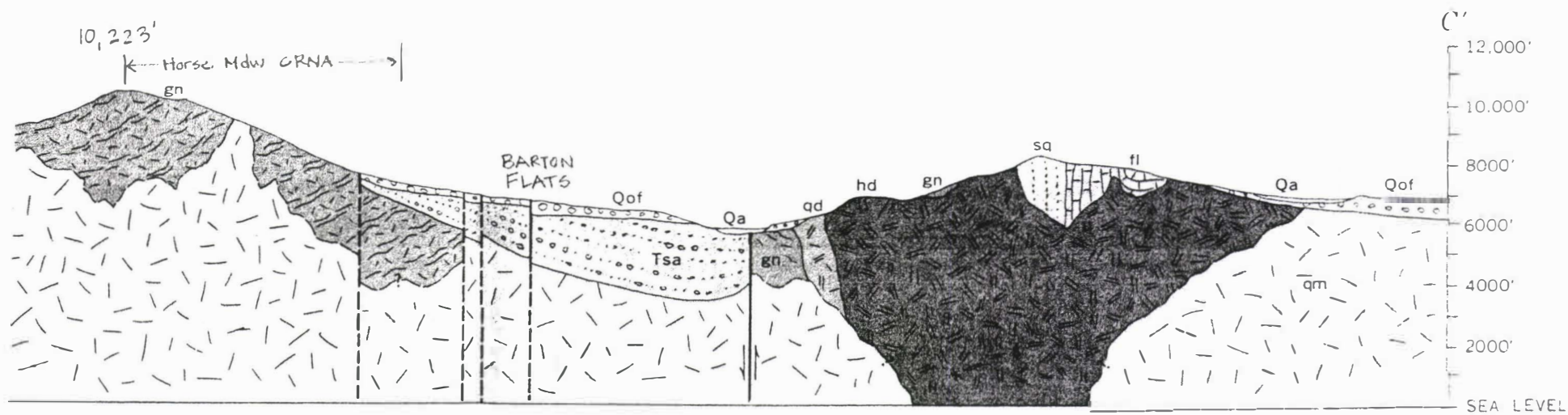
QUATERNARY OLDER SURFICIAL SEDIMENTS

Qof: Fanglomerate. (Pleistocene). Buff to light reddish-brown, massive to crudely bedded fanglomerate of unsorted boulders, cobbles, pebbles, and sand derived mostly from gneiss and quartz monzonite. In Barton Flats area as thick as 300 feet. Deposited as alluvial fans.

Qgt: Glacial Till. (Pleistocene). Unsorted angular fragments as large as 10 feet across of gneiss and quartz monzonite, carried downslope and deposited by glacial ice during the last ice age.



MAP 7. GEOLOGIC MAP: Horse Meadow Ridge candidate Research Natural Area. (from San Geronimo Mountain Quadrangle, Dibblee 1964).



MAP 8. VERTICAL GEOLOGY OF THE HORSE MEADOW RIDGE CANDIDATE RESEARCH NATURAL AREA.
(from San Geronio Mountain Quadrangle, Dibblee 1964).

KEY TO MAP 9: LEGEND FOR GEOLOGIC MAP OF THE SAN GORGONIO WILDERNESS (Abstracted from Morton et al 1980)

PRECAMBRIAN METAMORPHIC ROCKS

pEgs: Biotite Gneiss and Schist. Light to dark-gray, fine- to medium-grained, quartzo-feldspathic muscovite-biotite gneiss and schist, plus subordinate bititic and feldspathic metaquartzite and minor amphibolite. Pronounced compositional layering consisting of alternating mica-rich and quartz/feldspar-rich layers.

MESOZOIC (CRETACEOUS OR JURASSIC) PLUTONIC ROCKS

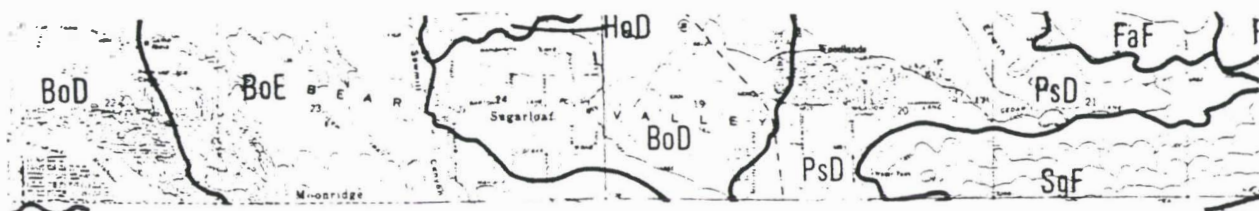
KJga: Granodiorite of Anderson Peak. Light-gray to greenish-gray, massive to foliated, equigranular biotite granodiorite. Rich in quartz (25-30%); plagioclase (40-50%) predominates over potassium feldspar (15-20%).

QUATERNARY SURFICIAL SEDIMENTS

Qc: Colluvium. Deposits of unconsolidated rock debris produced by mechanical weathering and mass wasting of steep bedrock slopes. Forms colluvial cones and aprons composed of angular pebbles, cobbles, and boulders.

Qof: Older Alluvial Fan Deposits. Unconsolidated or slightly consolidated light-gray to light-yellowish-brown deposits of sand and pebble to boulder gravel deposits of inactive alluvial fans. Deeply dissected by active stream channels. Slumping and sliding of older fan deposits has produced numerous large landslide masses along the north margin of the Wilderness area (not shown on map).

Qg: Glacial Deposits, Undivided. Unconsolidated to slightly consolidated sand and pebble to boulder gravel deposited by alpine glaciers.

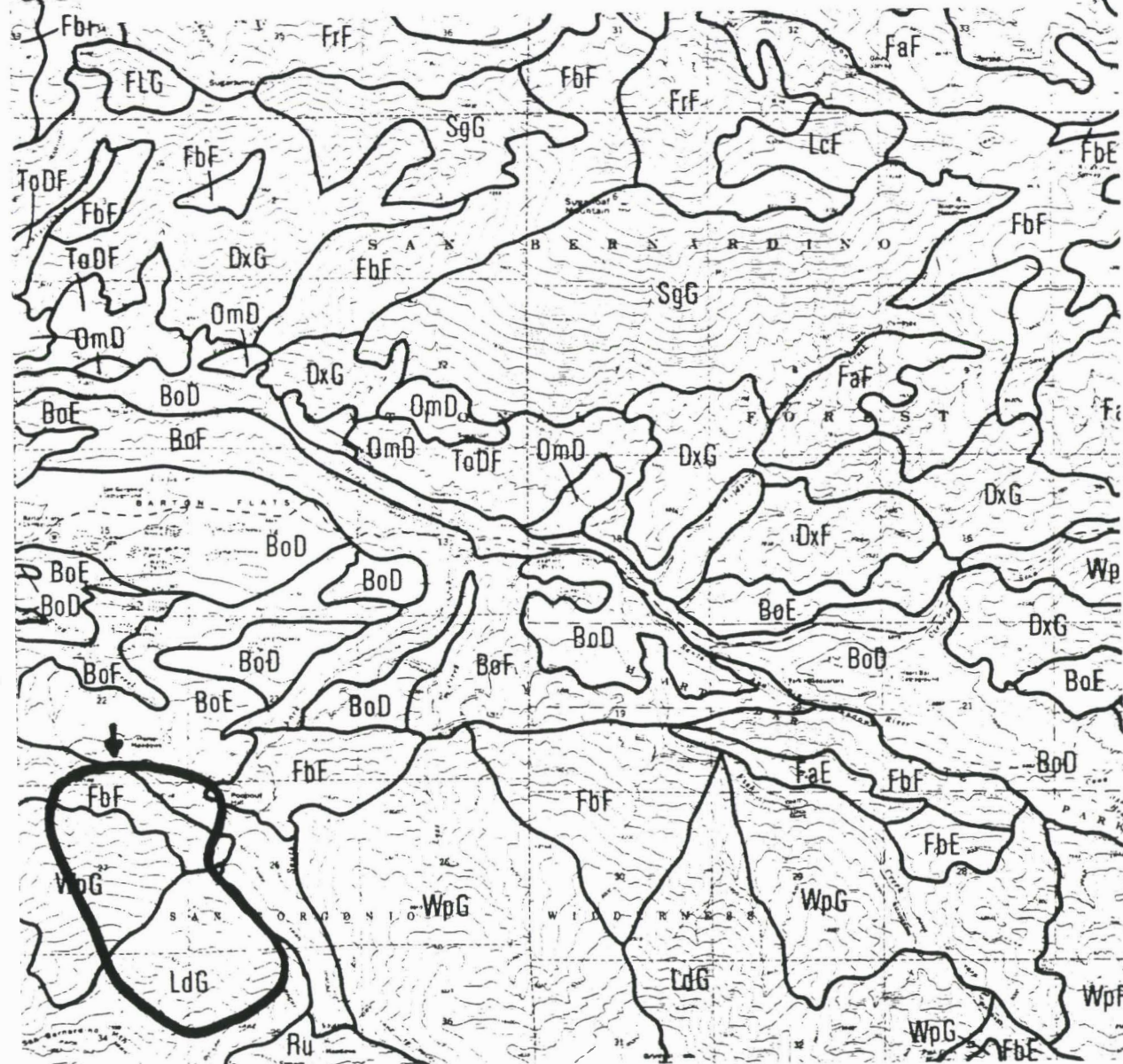


KEY TO SOIL MAPPING UNITS FOR HORSE MEADOW SOIL MAP.

(Abstracted from USDA-Forest Service, 1980).

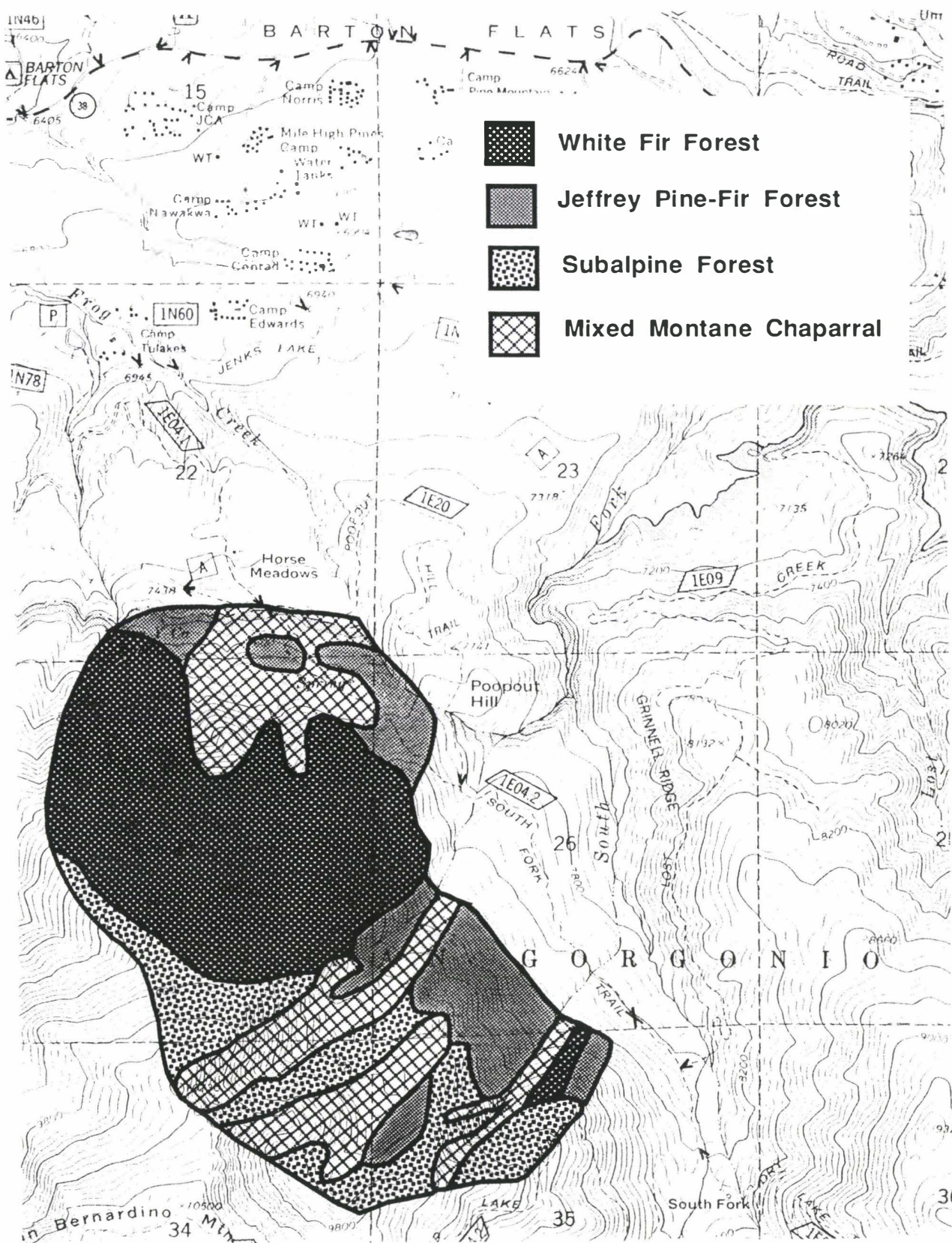
FbE

- BoE: Morical and Hecker families complex, 15 to 30 percent slope
- FbF: Merkel-Wapal families complex, 30-50 percent slope
- WpG: Wapal family- lithic xerorthents, cool association, 50-75 percent slope
- LdG: Lithic Xerorthents, cool - Rock outcrop complex, 50-100 percent slopes

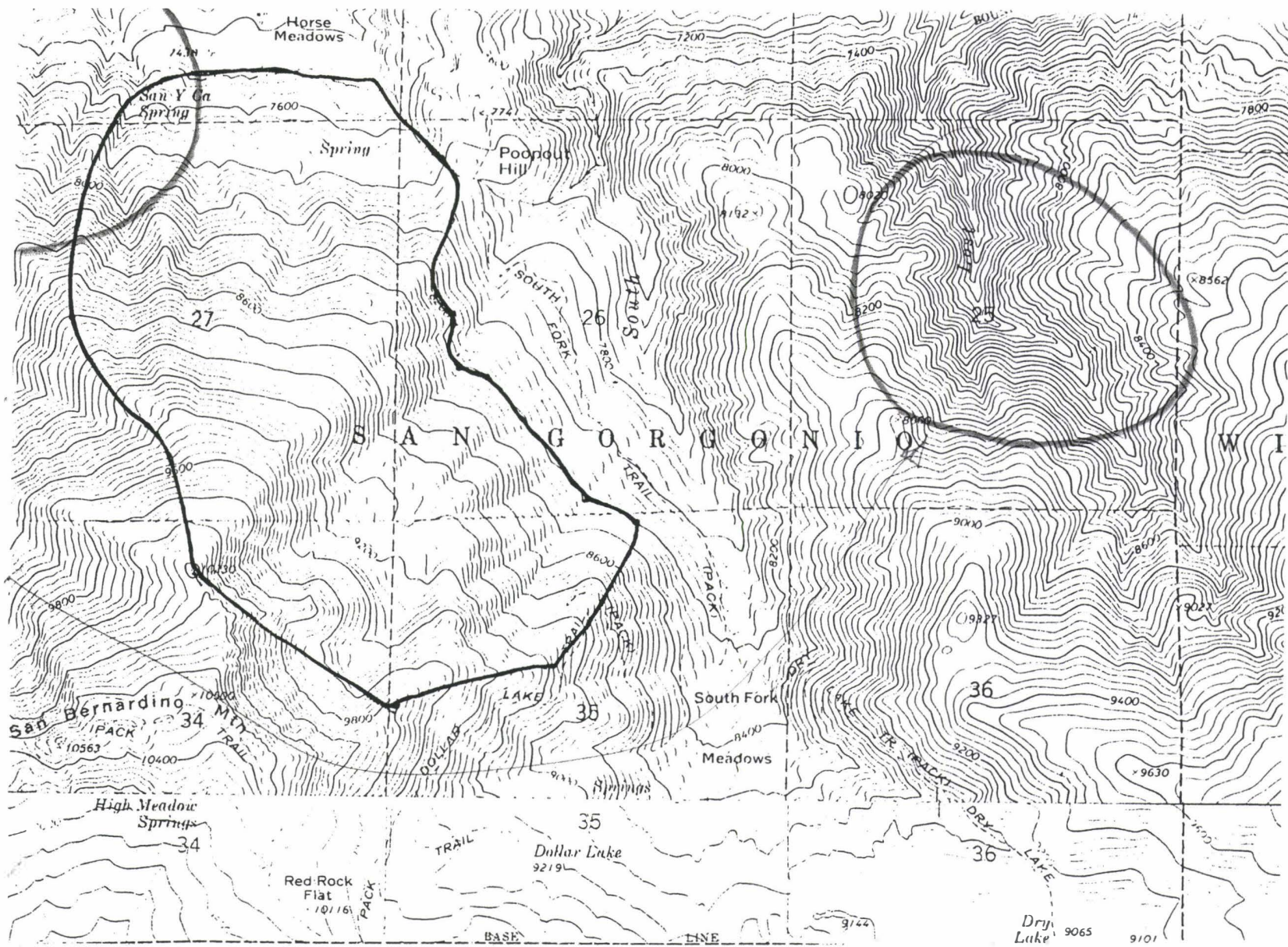


MAP 10. SOIL MAP: HORSE MEADOW CANDIDATE RESEARCH NATURAL AREA. (USDA-Forest Service 1980).





MAP 11. VEGETATION MAP: Horse Meadow Ridge candidate Research Natural Area.



MAP 13. SPOTTED OWL TERRITORY IN THE HORSE MEADOW VICINITY
(Bill LaHaye, pers. comm. Areas marked with heavy red line indicate Spotted Owl territory)



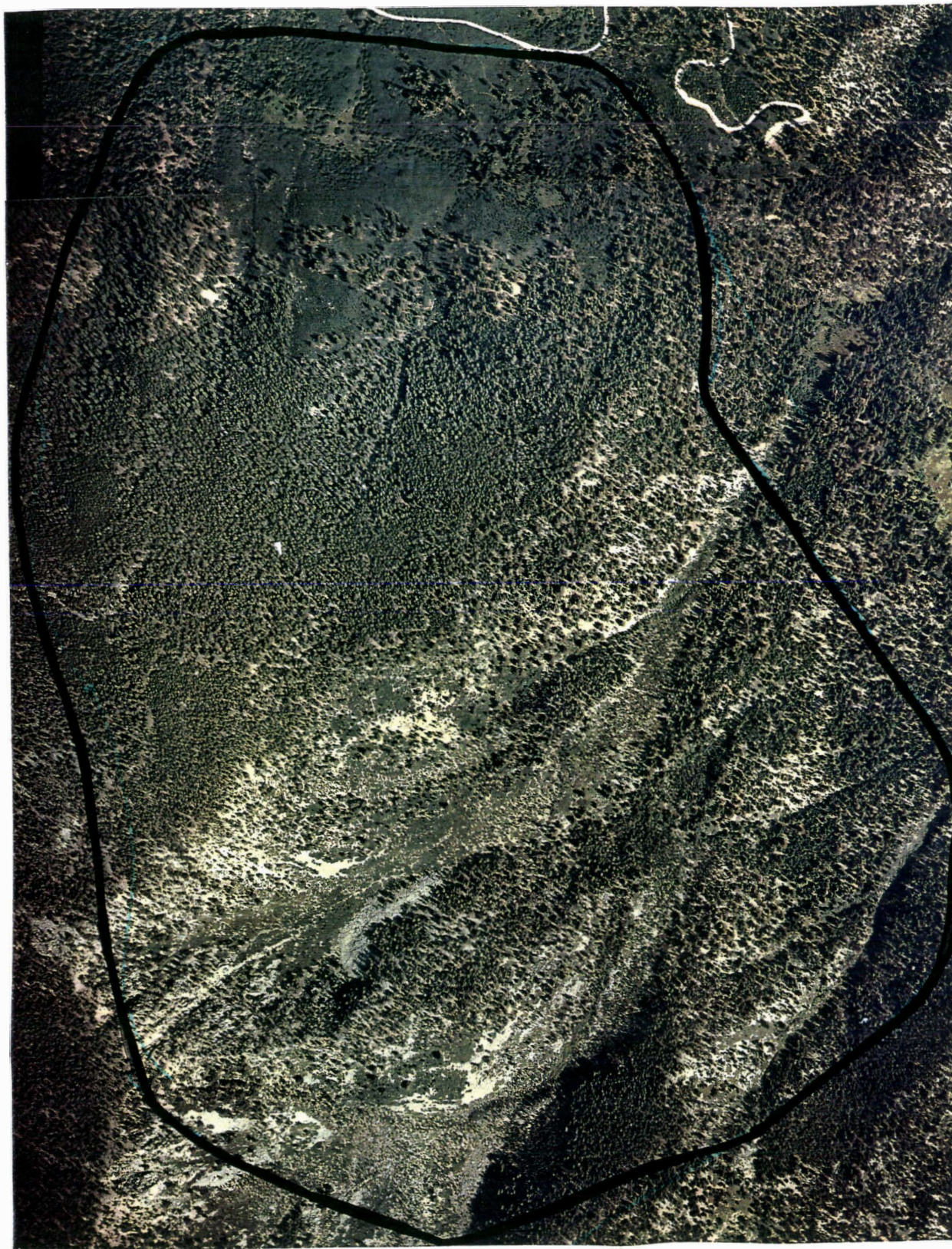


PLATE 1. Horse Meadow Candidate Research Natural Area. Natural Color Aerial Photograph.
3 September 1984. Soil Conservation Service. USDA 12-615120-1283-113 and 12-615120-
1283-115.



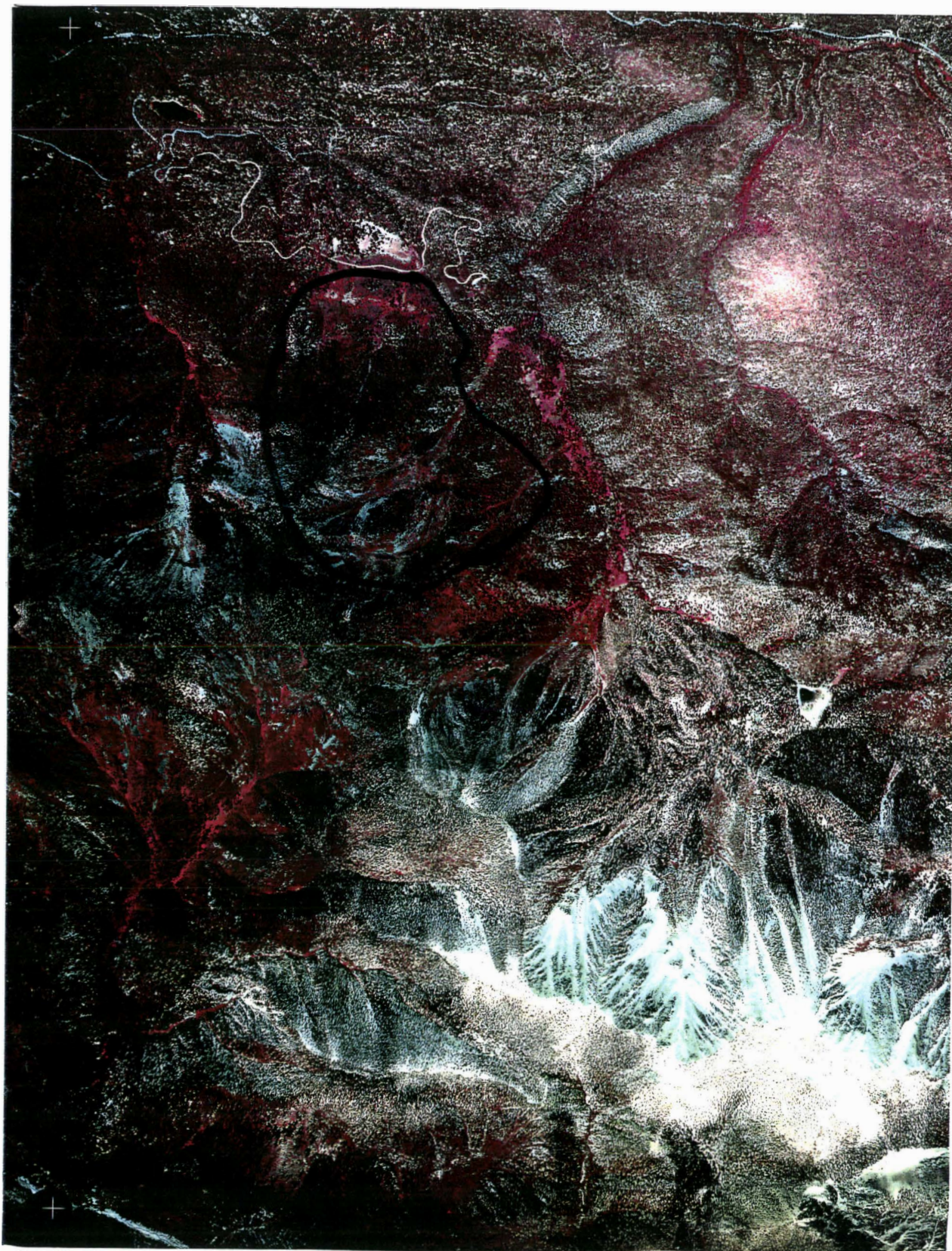


PLATE 2. Horse Meadow Candidate Research Natural Area.
Infrared Aerial Photograph. 20 August 1989.
Soil Conservation Service 082 NAPP 1839-083

PLATE 3. Horse Meadow White Fir Forest.

- a. General area photograph showing white fir forest on north-facing ridge of Horse Meadow Candidate Research Natural Area. Photo taken from South Fork Trail as it cross the *Ceanothus-Ribes* Mixed Montane Chaparral vegetation, shown in the foreground. Inclusions of jeffrey pine-fir forest occur along the edge and as islands within this chaparral expanse.
- b. Typical dense stand of young white firs on the steep unstable upper slopes of Horse Meadow cRNA.



a.

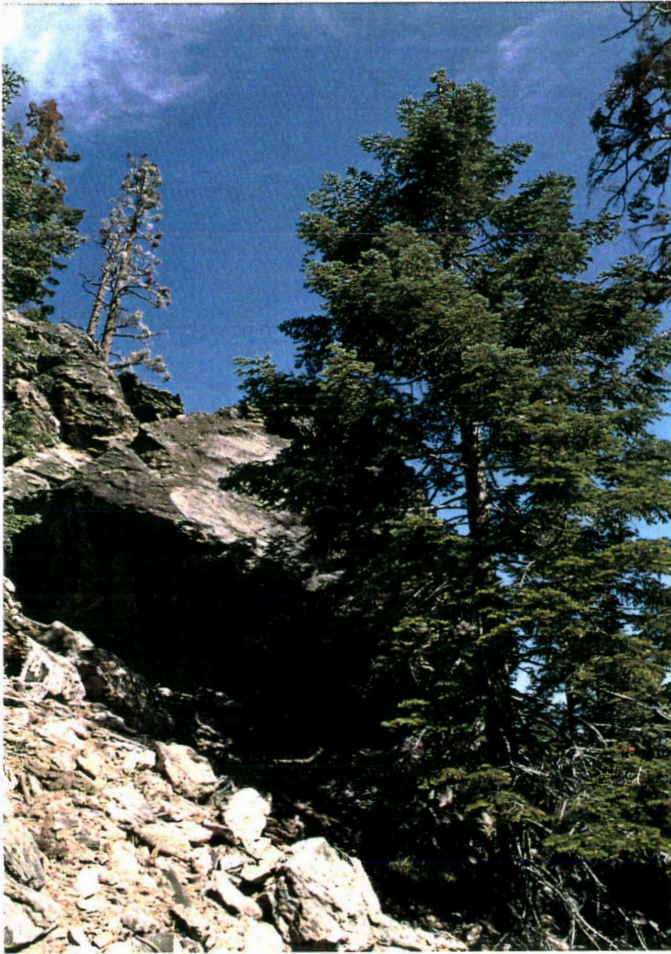


b.

PLATE 3. Horse Meadow White Fir Forest.

PLATE 4. Horse Meadow White Fir Forest

- a. In rocky outcrops at the top of the Horse Meadow ridge where tree roots can find stable soils, white firs can attain relatively large sizes.
- b. Large white firs also occur within the jeffrey pine-fir forest on the gentle slopes along the South Fork Trail. Although the large sizes of trees in this mature forest would add value to the cRNA, this area has been excluded from the cRNA because of its close proximity to the heavily travelled South Fork Trail.



a.



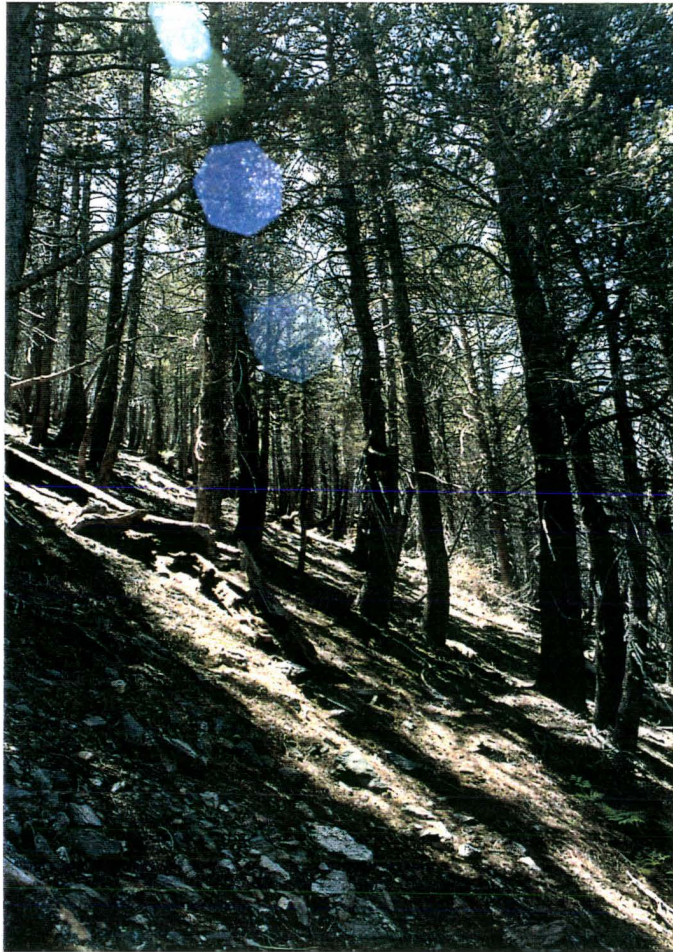
b.

PLATE 4. Horse Meadow White Fir Forest

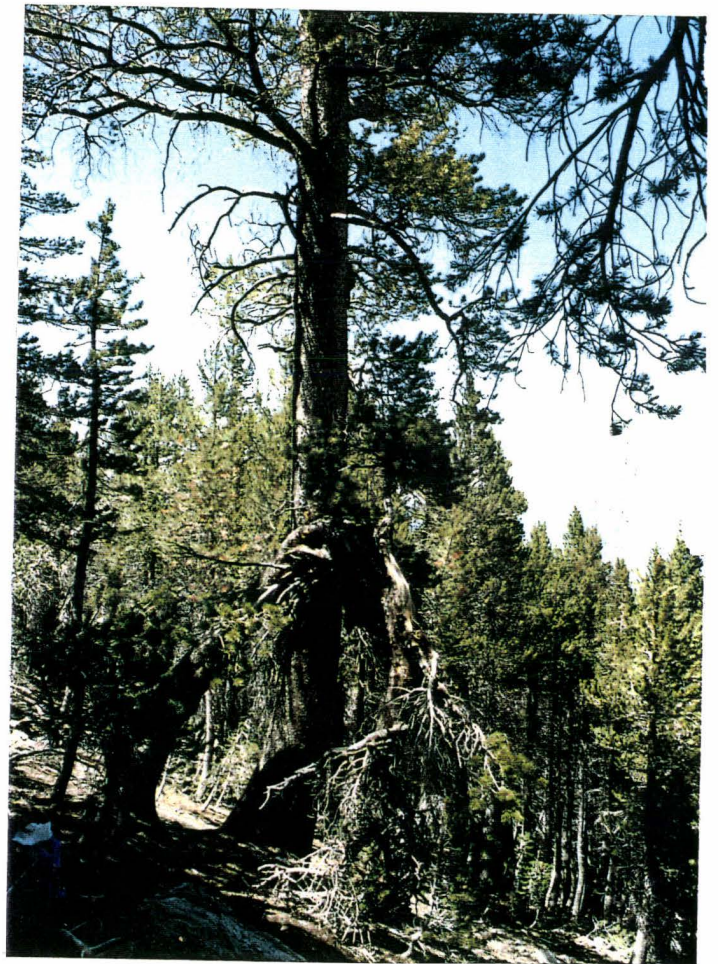
PLATE 5. Horse Meadow Subalpine Forest

- a. This very steep slope is characteristic of the high elevation sites where the southern California subalpine forest occurs. Dominance in this forest is shared by *Pinus contorta* spp. *murrayana* and *Pinus flexilis*.
- b. In pockets and swales of the upper slopes, where the snow lies late, the typically sparse understory of the subalpine forest is replaced by a relatively dense cover of braken ferns, columbines, and other herbaceous plants.
- c. These steep slopes, along with other areas at Horse Meadow cRNA, are subject to avalanches. This lodgepole pine was damaged, but not killed, by such an event.

a.



b.



c.

PLATE 5.
Horse Meadow
Subalpine Forest

PLATE 6. Horse Meadow Jeffrey Pine-Fir Forest

- a. The midslopes of the cRNA are also steep. Here the jeffrey pine-fir forest grades into the subalpine forest of the upper ridges.
- b. This midslope jeffrey pine-fir site, facing northeast, shows the open character of the understory. Soils are bare and rocky, and herbaceous cover is less than 1%. In the tree layer, dominance is shared between *Abies concolor* (50-60%) and *Pinus jeffreyi* (40-50%).



a.



b.

PLATE 6. Horse Meadow Jeffrey Pine-Fir Forest

PLATE 7. Horse Meadow Jeffrey Pine-Fir Forest: Shrubby Understory Associates

- a. *Chrysolepis sempervirens* and *Ceanothus cordulatus* are common shrubby associates in open areas of the jeffrey pine-fir forest.
- b. *Arctostaphylos patula* is another widespread and common shrub in this mixed conifer forest.

a.



b.

PLATE 7. Horse Meadow Jeffrey Pine-Fir Forest: Shrubby Understory Associates

PLATE 8. Horse Meadow Jeffrey Pine-Fir Forest: Herbaceous Association
Horse Meadow Montane Meadow

- a. In wetter areas of the jeffrey pine-fir forest, herbaceous cover increases. Associated plants include *Pteridium aquilinum*, *Erysimum capitatum*, *Penstemon grinnellii*, and *Poa fendleriana*.
- b. Where slopes are relatively level and soil moist is very high, lush Montane Meadows occur within the jeffrey pine-fir forest. These meadows are extensive outside the cRNA in the South Fork Meadow area.



a.



b.

PLATE 8. Horse Meadow Jeffrey Pine-Fir Forest: Herbaceous Association
Horse Meadow Montane Meadow

PLATE 9. Horse Meadow Jeffrey Pine-Fir Forest with Black Oak

- a. At the north end of the site, black oak (*Quercus kelloggii*) occurs in an open jeffrey pine-fir forest, near a riparian area dominated by *Salix*. Note the good reproduction of all tree species in this area.
- b. *Arctostaphylos patula* occurs in this open, level forest site as well.



a.



b.

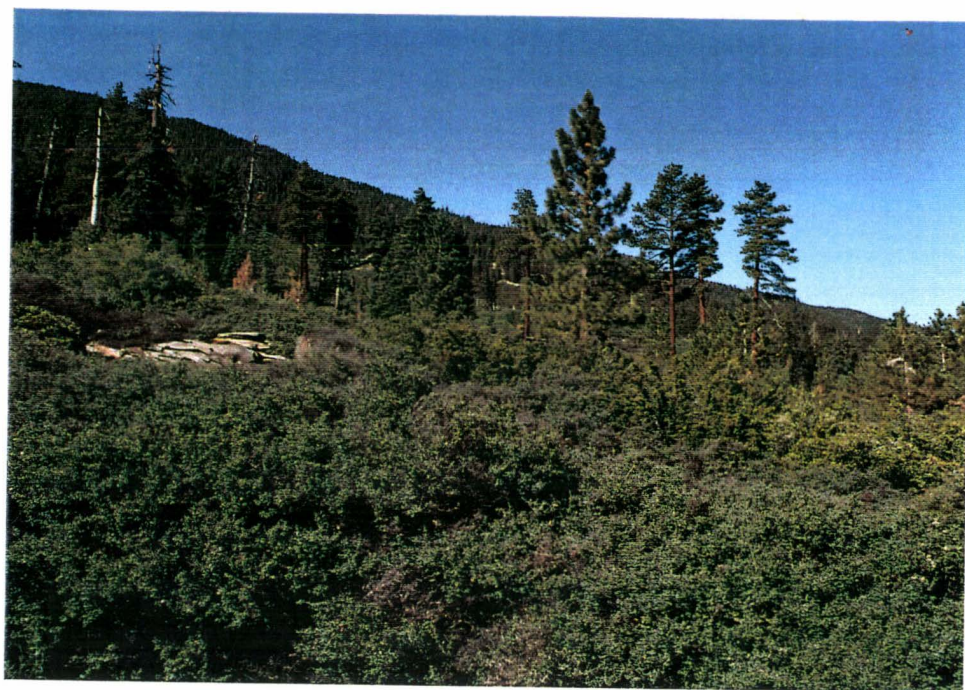
PLATE 9. Horse Meadow Jeffrey Pine-Fir Forest with Black Oak

PLATE 10. Horse Meadow Mixed Montane Chaparral

- a. This avalanche chute, choked with chinquapin, willows, and ceanothus, reaches all the way to the ridgeline of the Horse Meadow cRNA. Mixed montane chaparral occurs at Horse Meadow in two forms. This photo illustrates a chaparral dominated by *Chrysolepis sempervirens*-*Ceanothus cordulatus*-*Salix* spp.
- b. Where the South Fork Trail enters the cRNA, the mixed montane chaparral is dominated by *Ceanothus cordulatus*-*Ribes cereum*. This site is believed to be the site of a burn in 1959.



a.



b.

PLATE 10. Horse Meadow Mixed Montane Chaparral

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	SAN BERNARDINO COUNTY
DATE	ISSUED TO
4/11/94	Mazel Gordon
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